



UNIVERSITY
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Each undergraduate is expected to be familiar with the contents of this publication.

The rules and regulations published in this bulletin were in effect at the beginning of the 1982-83 academic year and are subject to change through established procedures of the University. Changes in academic rules and regulations usually are effective at the beginning of the academic year following their adoption. Administrative regulations (including tuition and fees) are subject to change without advance notice and are effective immediately upon adoption should authorities responsible for the development of such policies determine immediate implementation to be necessary.

"The University of Lowell is an Affirmative Action/Equal Opportunity University and does not discriminate on the basis of sex or handicap status in its educational programs, activities, or employment policies as required by Title IX of the Education Amendments of 1972 and Section 504 of the Rehabilitation Act of 1973, as amended."

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1982-86



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MESSAGE FROM THE PRESIDENT

The University of Lowell can provide you with a variety of rewarding educational experiences. Much of the knowledge which is our intellectual heritage and many of the research discoveries which promise to expand and reshape our concepts of mankind and our views of the world are reflected in University courses and curricula. I hope that the University will become a place in which you will grow and develop and that you and the University will be enriched by your presence on campus. This bulletin describes in detail all the essential information concerning undergraduate education. To make the most of your educational experiences, you should familiarize yourself with its contents.

William T. Hogan

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UNIVERSITY PROFILE

The University of Lowell was established by Chapter 1175, Acts of 1973, General Laws of the Commonwealth of Massachusetts, through a merger of Lowell State College and Lowell Technological Institute, Chapter 1175 directs the University to "provide, without discrimination, educational programs, research, extension, and continuing education services in the liberal arts, engineering and the sciences, and in the professions. The University of Lowell shall offer the adult education services of the university extension program. . . and shall, with the approval of the board of trustees and the board of regents, have general authority to award any earned doctoral degrees."

Lowell State College and Lowell Technological Institute were established in the last decade of the 19th century as single purpose institutions and were charged with providing instruction in those theories and practical arts which were most suitable to the teaching profession and the textile industry. Lowell State College was chartered by the General Court of the Commonwealth on January 6, 1894, as a teacher-training institution and was assigned the responsibility for providing "the most thorough knowledge of the branches of learning required to be taught in the schools, the best methods of teaching these branches, and right mental training." In 1932, the institution was made a four-year college and was granted the right to confer baccalaureate degrees. In 1960, the college became a multi-purpose institution by initiating non-teaching programs in the liberal arts. During the next decade and a half, the college continuously extended its mission and curriculum offerings at both the graduate and undergraduate levels and was authorized to offer degree programs in education, the health professions, the liberal arts and sciences, and music. From the time of its origin in 1895 as a proprietary textile school, Lowell Technological Institute has provided educational programs of an applied and practical nature. "Science and art will be taught," the original prospectus pointed out, "with a view to industrial and commercial applications" and for "the purpose of improving any special trade or of introducing new branches of industry." The control of the School was transferred to the state in 1918, and in 1928 it was granted collegiate status. In 1953, it became a multi-purpose technological institute. During the last decade, the Institute phased out its textile curricula, extended its curriculum offerings in engineering and technology, the pure and applied sciences, business administration and industrial management, and received authorization to offer degrees through the doctorate.

The merging of Lowell State College and Lowell Technological Institute has brought together two multi-purpose institutions of differing character and orientation and has made possible the creation of a comprehensive university whose strengths and resources are manifestly greater than those possessed by the previous institutions. At the present time, the University has a faculty in excess of 500 and a student enrollment of more than 14,000. The curricula of the University encompass the customary disciplines of the liberal arts and sciences, as well as a wide range of professions.

MISSION OF THE UNIVERSITY

The University of Lowell is a publicly-supported institution of higher learning located in the northeast section of Massachusetts. It seeks to discover, integrate, and transmit knowledge. The University emphasizes programs in the professional areas of education, engineering, health, management, music and science. At the same time, the University strongly believes in the values of a liberal arts education both for its own sake and as a major component of professional preparation.

Degree programs are offered at the bachelor, master and doctorate levels. Graduate programs concentrate in those areas where there is a strong regional need or where the University possesses superior resources. The University also provides maximum opportunity for life-long learning through a wide variety of credit and non-credit continuing education courses.

The University is committed to the promotion of scholarly research and creative, artistic achievement. It seeks to create new knowledge in the belief that an atmosphere of original inquiry supports both the instructional and public service goals of the University.

The University has a special obligation to provide quality teaching in all its academic programs. It will continually seek more effective methods of imparting knowledge and understanding thus enabling its students to fully develop their abilities.

Recognizing its role as a public institution, the University provides service to the people of the Commonwealth through instruction, research and consulting, cultural events, and continuing education. The University will, through its staff, continue to remain visible through its involvement in community service affairs.

Finally, the University has a responsibility to implement the principles of equal opportunity and affirmative action. It is committed to ensuring that all students and employees, particularly those in protected designations, are guaranteed the benefits of a just and equitable system.

ACCREDITATION AND PROFESSIONAL MEMBERSHIPS

The University of Lowell is an accredited member of the New England Association of Schools and Colleges. Professional programs at the baccalaureate level are also accredited by the following national associations:

- Accreditation Board For Engineering and Technology
- American Chemical Society
- American Physical Therapy Association
- National Accrediting Agency for Clinical Laboratory Sciences
- National Association for Industrial Technology
- National Association of Schools of Music
- National Association of State Directors of Teacher Education and Certification
- National Council for the Accreditation of Teacher Education (Elementary Education, Music Education, and Health Education)
- National League for Nursing

Accreditation indicates that the University is recognized and approved by regional and national associations concerned with the quality of higher education and it assures that study undertaken here has transfer value to other accredited institutions of higher education. The University is also a member of the following associations of higher education:

- American Association of Colleges for Teacher Education
- American Association of Colleges of Nursing
- American Council on Education
- Assembly of Collegiate Schools of Business
- Association for State Colleges and Universities
- College Entrance Examination Board
- Council of Colleges of Arts and Sciences
- National Association of Summer Sessions
- National University Continuing Education Association
- New England Board of Higher Education

UNIVERSITY ORGANIZATION AND GOVERNANCE

The University is organized into five service areas, each of which is under the supervision of a vice-president. The academic organization of the University has been designed to promote a challenging environment in which creative thinking and educational freedom will permit individual growth and professional competency. Instructional units are grouped in colleges, schools, and departments. The University includes seven colleges and a graduate school, each under the direction of a dean and a college faculty. In addition, an evening school of continuing education operates under a director and in conjunction with the seven colleges and the graduate school.

University Instructional Units

College of Education

The College of Education is located in Dugan Hall (South Campus), which houses both the Office of the Dean and offices of the faculty. The College of Education offers baccalaureate programs in elementary education and graduate programs in curriculum and instruction, educational administration, and reading and language. Clinical aspects of teaching programs are conducted in the public schools of the Greater Lowell and Merrimack Valley areas. The Magnet Art School of the City of Lowell shares College facilities in Dugan Hall.

College of Engineering

The College of Engineering is housed in the following facilities on the North Campus: Ball Hall, Engineering Building, Kitson Hall, and Pasteur Hall. Located in Ball Hall are the Department of Electrical Engineering, Mechanical and Energy Engineering, and Plastics Engineering. The Department of Chemical Engineering and the Department of Industrial Technology are located in the Engineering Building. The Department of Civil Engineering is located in Pasteur Hall. The office of the Dean is located in Kitson Hall.

College of Health Professions

The College of Health Professions is located in Weed Hall (South Campus), which houses both the Office of the Dean and offices of the Department of Clinical Laboratory Sciences, the Department of Health, and the Department of Nursing. Special classroom and laboratory facilities are also located in Weed Hall. Offices of the Department of Physical Education are located in the Costello Gymnasium (North Campus) and Mahoney Hall (South Campus).

Facilities of the College include fully equipped simulated laboratories in the areas of clinical chemistry, clinical hematology, microbiology, and clinical immunohematology. Also included are three simulated nursing laboratories which have the most modern nursing and life-support equipment available. The audio-visual center has carrels which are equipped for self-paced instruction in basic nursing skills.

Clinical experiences for health education, health services administration, medical technology, nursing, and physical therapy programs are conducted in public schools, health agencies, and hospitals of the Greater Lowell and Merrimack Valley areas.

College of Liberal Arts

The Office of the Dean of the College of Liberal Arts is located in Mahoney Hall (South Campus). Faculty offices of the College are located in several buildings on both campuses. Offices of department chairpersons are located in the following buildings:

Art
English
History & Political Science/Law & Justice
Languages
Philosophy
Psychology
Sociology

Coburn Hall, South Campus
Falmouth Hall, North Campus
Coburn Hall, South Campus
Coburn Hall, South Campus
Mahoney Hall, South Campus
Mahoney Hall, South Campus
Coburn Hall, South Campus

Facilities of the College include experimental laboratories for animal and human learning, a criminalistics laboratory, language laboratory facilities, theatre arts workshops, and a performing theatre. Practicum experiences for social science curricula are conducted in social and government agencies of the Greater Lowell and Merrimack Valley areas.

College of Management Science

The College of Management Science is located in Falmouth and Pasteur Halls on the North Campus. The Department of Management offices are located on the third floor of Falmouth Hall. The Accounting and Economics Departments are located on the second and third floors of Pasteur Hall. The Office of the Dean is in Pasteur Hall.

College of Music

The College of Music is located in Durgin Hall (South Campus). Durgin Hall contains a concert hall seating one thousand and features an acoustical shell on the stage, an orchestra pit which can be raised and lowered, and a flexible lighting console. The recital hall, which seats two hundred and fifty is ideal for student and faculty recitals and houses a Schlicker organ of eleven ranks. Seventy-two practice cubicles, twelve classrooms, and sixteen teaching studios, a recording studio with state of the art professional recording equipment, two electronic piano laboratories and an electronic music laboratory provide basic facilities to study, teach, and perform.

College of Pure & Applied Sciences

Offices of the College of Pure and Applied Sciences are located in Olsen, Olney and Pinansky Halls (North Campus). The Office of the Dean is located in Olney Hall. Offices of department chairpersons are located in the following buildings:

Biological Sciences
Chemistry
Computer Science
Earth & Environmental Sciences
Mathematics
Physics

Olsen Hall
Olney Hall
Pinansky Hall
Olney Hall
Olsen Hall
Olney Hall

Modern facilities and equipment in the Olsen, Olney and Pinansky buildings and in Weed Hall (South Campus) include teaching laboratories, modern computer equipment, undergraduate and graduate research facilities, office research modules and such service areas as animal quarters, rooms for instrumentation, preparation, temperature and humidity control as well as X-ray, electron microscope (transmission and scanning), greenhouse, and library facilities.

Continuing Education and Summer School

Continuing Education offers degree programs at both the graduate and undergraduate levels, as well as credit and non-credit courses for part-time, non-matriculating students.

A broad spectrum of courses is offered during the late afternoon and evening to fulfill the educational needs of employed persons and others in the Merrimack Valley area who are restricted to part-time attendance. The sequence of courses is designed for vocational and professional career development, with emphasis on updating and modifying the individual's occupational preparation base. The matching of academic program with systematic job progress over a period of years provides for a total development of the individual in quest of professional advancement. Continuing Education offices are located in Cumnock Hall (North Campus).

Two terms of summer school are offered by the University. Although course offerings depend upon student demand and may vary from year to year, summer school courses in recent years have comprised a major portion of the regular academic program. Summer courses are generally taught by full-time faculty of the University and are equivalent to courses which are offered during the fall and spring semesters. Students who wish to accelerate their baccalaureate studies or who wish to make-up courses which they have failed during the regular academic year may pursue summer school courses with the assurance that they are creditable to degree programs of the University. Offices of the Summer School are located in Cumnock Hall (North Campus).

All Continuing Education degree programs are under the supervision and control of resident University faculty.

Graduate School

The Graduate School offers advanced studies, including professional training and research, leading to graduate degrees in education, engineering, management, music, nursing and science. In addition to the day classes intended primarily for full-time graduate students, the Graduate School offers some evening classes through the Evening School for the convenience of part-time students. The courses offered in the evening are equivalent to those offered to full-time graduate students. Offices of the Graduate School are located in Cumnock Hall (North Campus).

University Service Facilities

Computer Center

The University Computer Center provides a wide range of facilities for academic computing in support of classroom teaching and research at both the undergraduate and the graduate level. The central computer facility consists of a CDC CYBER 170-720 Computer System with a full complement of peripherals and terminals to support batch, remote batch, and interactive time-sharing environments. The computer system provides direct access to its resources through a telecommunications network. The operating system software includes Assembler, FORTRAN, COBOL, BASIC, ALGOL, APL, PASCAL, Data Base Management System, and a library of application packages including SPSS, TSP, ASCL etc., computer graphics capabilities (general purpose, business graphics, engineering CAD/CAM etc.). In addition, the Computer Center has recently installed Data General MV/8000 systems, and a WANG VS/80 computer. The computer facilities are supported by the Computer Center organization with a professional and support staff of twenty-one persons.

Research Foundation

The Research Foundation (North Campus) was established in 1950 as a not-for-profit organization which operates from income derived from research funded by private industry, foundations and government agencies.

Housed in a modern building adjacent to the main resident hall complex of the North Campus, the Foundation contains major support facilities for faculty and student research projects. The Foundation provides a mechanism for the administration and fiscal management of all academic grants and contracts. Two auxiliary enterprises, the Metrology and Testing Divisions, help to defray the overhead costs of the facility. Metrology services are provided to assist industry and government through the repair and calibration of electronic test equipment with traceability to the National Bureau of Standards. This service is available from the Foundation or its fully equipped mobile laboratory. Also based at the Foundation are the Center for Atmospheric Research and the Center for Tropical Disease.

As part of its close cooperation with the University, the Research Foundation employs both graduate and undergraduate students from the University on a part-time basis. These students gain practical experience which often leads to an advanced degree. In addition to the research which is carried out on campus, research projects have been conducted in Thailand, Greece, Italy, Germany and Algeria. Currently, research projects are being conducted in Labrador, England, Jordan, Brazil, Egypt and other parts of the world where the University is becoming known for its significant expertise. For further information, contact Mr. Edward F. Miller, Jr., Executive Director, University of Lowell Research Foundation, 450 Aiken Street, Lowell, Massachusetts 01854.

UNIVERSITY COUNCIL

Subject to the final authority of the Board of Trustees and the Board of Regents of Higher Education, the University Council is the principal legislative and policy-making advisory body of the University community. In accepting this responsibility, the Council recognizes a duty to respect and safeguard the civil liberties, academic freedoms, and professional ethics of individual members of the University, associated groups of persons within the University, and individuals or groups invited to the University. For this purpose, members of the student body, the faculty, the administration, the professional staff, and the non-professional staff have equal claim to the protection of the Council.

Powers and Functions of the Council

1. General responsibility for non-academic matters of campus life, such as parking regulations, cultural events, and social activities;
2. Legislative authority over all University-wide academic policies (including but not necessarily limited to the following: standards for admission, retention, graduation, University honors, and University awards; policies concerning class attendance, the grading system, academic petitions and special actions, examinations, student transfer, and academic probation, suspension, and dismissal; procedures concerning course equivalency and University registration; and introduction of new degree programs);
3. Legislative authority concerning standards for student discipline in academic cases;
4. Legislative authority for the academic calendar to the extent that it does not alter the terms and conditions of faculty employment;
5. General authority to study and to make recommendations within the University community on matters it deems appropriate, including long-range planning, the annual budget, the allocation of available resources, and other matters of compelling significance;
6. General authority, subject to the approval of the President and the Board of Trustees, to make recommendations to local, state, and federal governing boards;
7. General authority to establish such committees as appropriate to carrying out its powers and functions; and
8. General authority to draw up rules and regulations for its own operation.

Council Membership

1. Twenty-one (21) faculty members: one (1) elected from each college, thirteen (13) elected at large, and the Chairperson of the Faculty;
2. Ten (10) students: eight (8) undergraduates and two (2) graduates to include the President of the Interdormitory Council, the President of the Graduate School Association, and the President of the Student Government;
3. Six (6) administrators: the Vice-President for Academic Affairs, the Vice-President for Student Affairs, the Vice-President for Business Affairs, two administrators elected at large by administrators of the University, and one college dean elected by the college deans of the University;
4. Three (3) members at large to be appointed by the President;
5. Two (2) members of the alumni living in the Greater Lowell community and not employees of the University of Lowell appointed by the Alumni Association;
6. The immediate past Chairperson of the University Council as *ex officio*, non-voting member.

ADMISSION POLICIES

Baccalaureate degree programs are offered by the Colleges of Education, Engineering, Health Professions, Liberal Arts, Management Science, Music, and Pure and Applied Sciences. Undergraduate degree programs at both the associate and baccalaureate degree levels are offered by the Evening School of Continuing Education. These programs are offered primarily for part-time students and are not described in this publication. Information concerning admission policies, curricula and academic policies of continuing education programs may be found in the *Bulletin of Continuing Education & Evening School*.

Entering freshmen who prefer to test their abilities and interests or who wish to explore several areas of study before identifying themselves with one of the baccalaureate day programs can request admission as undeclared students. *Students transferring with 60 or more credits may not request status as undeclared students and must enter the University with a commitment to an academic major or professional program.*

Enrollments in certain professional programs (including, in the College of Health Professions, clinical laboratory sciences, nursing, and physical therapy) are limited. Undeclared students should be aware that openings may be inadequate to accommodate all qualified applicants at the time when program declarations must be made upon completion of 60 credits.

*Entering students wishing to attend University summer sessions prior to initiating full-time studies are referred to "University of Lowell Continuing Education & Summer School Courses", p. 69.

Programs of the College of Education

Elementary Education

(Undergraduate Program terminates with the class of 1985.)

Programs of the College of Engineering

Chemical Engineering

Civil Engineering

Electrical Engineering

Industrial Technology

Mechanical Engineering

Nuclear Engineering

Plastics Engineering

Programs of the College of Health Professions

Clinical Laboratory Sciences

Health Education

Health Services Administration*

Nursing

Physical Therapy

*Program terminates with the class of 1985. Freshman students will not be admitted after Sept. 1982.

Programs of the College of Liberal Arts

Administration of Law & Justice

American Studies

Art

English

French

History

Modern Languages

Philosophy

Political Science

Psychology

Sociology

Spanish

Programs of the College of Management Science

Business Administration +

Economics

Industrial Management

+ Options available in Accounting, Economics, and Management

Programs of the College of Music

Music

Music Education

Musicology

Music Theory

Performance*

*Program options include Recording Technology, and Music & Business, Jazz

Programs of the College of Pure and Applied Sciences

Biological Sciences

Computer Science

Chemistry

Environmental Sciences +

Mathematics*

Meteorology

Physics#

Radiological Health Physics

+ Geology option available

*Options available in Applied or Pure Mathematics, Computer Programming, and Mathematical Statistics

#Options available in Optics & Applied Physics

GENERAL ADMISSIONS POLICIES

Admission to all baccalaureate day programs is made through the Office of Admissions and according to established undergraduate policies. Admission to programs of continuing education or to Summer School does not constitute admission to baccalaureate day programs and implies no commitment, per se, for subsequent application of continuing-education or summer-school courses to baccalaureate day programs. An individual who is admitted by the Office of Admissions as a baccalaureate degree candidate must be accepted by one of the colleges of the University as an undeclared student (entering freshmen or transfers with no more than 60 semester credits) or as a declared student with a commitment to an academic major or professional program. *When resources of a college or program limitations render it necessary to establish admission quotas, differential admission criteria above and beyond the minimum University admission requirements will be applied in the selection of applicants as matriculating students.*

To be admitted for undergraduate matriculation, an individual must present an academic performance record which indicates a reasonable probability of success in his or her chosen day program or college. In the case of freshman admission to undergraduate degree candidacy, performance is measured through the high school record and standardized test results. In the case of advanced standing students, performance is measured either by success as a matriculated student at some other accredited institution of higher education or by success at the University of Lowell as an associate or baccalaureate degree candidate in the Evening School of Continuing Education or as a non-matriculated student in the Second Chance Program for Adults or the Educational Opportunities Program. Within the space available in particular day programs, admissions are offered first to those whose performance record indicates the highest probability of success in the chosen program or college.

Individuals who are admitted by the Office of Admissions as non-matriculating students are admitted on a semester-by-semester basis and solely for courses which are designated at the time of admission. Such admission is granted only within provisions which govern special plans of non-degree studies as are described under the heading "Application Procedures with Non-Matriculating Students."

Depending upon enrollment restrictions, application deadlines vary for engineering, management science, clinical laboratory sciences, nursing, and physical therapy programs. Individuals who apply after the closing dates which are specified for these programs may be offered waiting list status. An applicant who has been approved for admission to restricted programs will be advised in his or her letter of the specific deadline for accepting an offer of admission and for making a required tuition deposit. For all other baccalaureate programs, the University operates on a rolling admission plan. An applicant who has been approved for admission to any program other than those which are specified above as having enrollment restrictions is required to notify the Office of Admissions of his or her acceptance of an offer of admission within twenty days of the date of the official acceptance letter and to make a required tuition deposit. A refund of the tuition deposit will be made to individuals who notify the Office of Admissions by May 1st that they wish to cancel their University admission. A refund of the tuition deposit will not be made after May 1st.

It is the policy of the University of Lowell that students seeking admission will be evaluated on their merits and (as prescribed in applicable federal and state laws) without respect to their race, color, creed, national origin, age, sex, handicap, or marital status. The University makes a special attempt to attract students from various racial backgrounds in disadvantaged environments.

APPLICATION PROCEDURES AND REQUIREMENTS FOR MATRICULATING STUDENTS

Application Procedures and Requirements for Graduating High-School Seniors and High-School Graduates

Graduating high-school seniors and high-school graduates who wish to be admitted to the University as matriculating students should (1) complete prior to April 1 the application form of the University of Lowell, (2) request high-school principals or guidance directors to forward to the Office of Admissions transcripts of secondary school grades—including grade reports for at least the first quarter of the senior year, (3) complete the College

Board Student Descriptive Questionnaire, and (4) arrange to take the College Entrance Examination Board Scholastic Aptitude Tests. Detailed information concerning the College Entrance Examination Board tests and the dates throughout the year on which they will be given may be secured from the Office of Admissions of the University of Lowell, high-school principals or guidance directors, or the Educational Testing Service (Princeton, New Jersey). Special information is provided in the following sections concerning required aptitude examinations for applicants to music programs and satisfaction of departmental language requirements through the Foreign Language Achievement Tests of the College Entrance Examination Board. Following receipt of application forms, transcripts of high-school records and scores of the Scholastic Aptitude Tests, the Office of Admissions may arrange appointments for personal interviews of applicants.

The responsibility for having all credentials forwarded to the University of Lowell *rests solely with the applicant*. Correspondence from students who may need assistance in adapting their high-school programs to satisfy specific requirements of the University is welcomed. Such correspondence should be addressed to the Office of Admissions, University of Lowell, Lowell, Massachusetts 01854. Requests for application forms should be directed to the same office.

Secondary School Preparation

The University of Lowell supports the efforts of secondary school officials and governing bodies to have their schools achieve regional accredited status to provide reliable assurance of the quality of the educational preparation of its applicants for admission.

The University desires applicants to present course work which has been undertaken with college preparatory curricula, specifies a minimum high school grade-point average of 2.50 (on a 4.00 scale) for the admission of degree candidates, and, all things being equal, places primary emphasis upon the high school record in identifying candidates for admission. An individual whose high school average is below the required minimum may be considered for admission, however, if he or she presents verbal and mathematics scores on the Scholastic Aptitude Tests of the College Entrance Examination Board which are higher than those which are specified for the admission of degree candidates by the college or program to which the individual has applied.

The following is a suggested pattern of high school courses for students who wish to apply to programs other than those which specify a particular set of course requirements.

English	4 units
College Mathematics	2 units
American History and Social Studies	2 units
Laboratory Science	1 unit
Electives	7 units

Applicants for admission to the College of Liberal Arts who wish to major in English or history are advised to present two units of course work in a single classical or modern foreign language. Individuals wishing to major in French or Spanish in the College of Liberal Arts are advised to present four units of high school courses in their intended language. Applicants for the program in modern languages should present two units each in two modern foreign languages or two units in one modern foreign language and two units in Greek or Latin.

Students who wish to major in the health professions (health education, health services administration, clinical laboratory sciences, nursing, or physical therapy) are required to present biology and chemistry as part of their secondary school course work and must present a minimum high school grade-point average of 2.50. A course in physics is also recommended.

For admission to courses of study in pure and applied sciences, engineering, and industrial management, applicants must have completed the following units of secondary school study:

Algebra (quadratics and beyond)	2 units
Plane Geometry	1 unit
Trigonometry	1/2 unit
English	4 units
American History	1 unit
Chemistry (including laboratory)	1 unit
or	
Physics (including laboratory)	1 unit

Preference is given to applicants offering both chemistry and physics. Those individuals who do not offer both subjects are urged to pursue the appropriate course work in summer school. Applicants to programs in pure and applied sciences, engineering, and industrial management may offer credits in areas other than those which have been specified above in languages, history, mechanical drawing, social studies, and other sciences.

Required Admissions Examinations

Applicants for admission to the University as matriculating students are required to take the Scholastic Aptitude Tests of the College Entrance Examination Board during the period from April of the junior year to March of the senior year. Although an individual who fails to achieve the desired SAT verbal and mathematics scores may be admitted to many programs if he or she evidences high academic motivation and possesses a high-school record which is better than the specified University minimum, the general expectation of the University is that an entering freshman shall have achieved the minimum SAT scores which have been specified for the college or program to which he or she has applied.

College	Programs	SAT-verbal	SAT-mathematics
Liberal Arts	All	400	400
Pure & Applied Sciences	All	450	550
Education*	NA	NA	NA
Engineering	Engineering	400	500
	Indust. Technology	400	400
Health Professions +	All	450	450
Management Science	All	450	450
Music	All	400	400

Programs of the College of Education are not open to freshmen.

+ Specified requirements may not be waived.

Achievement Tests of the College Entrance Examination Board are not required for admission, but the University may advise accepted students to take these tests and those of the College Level Examination Program or of University departments for purposes of placement or advanced standing with credit. Students who wish to apply for music programs are required to achieve satisfactory scores on written tests of musical aptitude and basic music theory which are developed and administered by the College of Music. Such students are also required to demonstrate their vocal or instrumental ability during a jury examination before a committee of music instructors. Music aptitude and performance tests are given by the College of Music on four different occasions during the academic year. Applicants will not be invited to take the special music tests at the University until all their credentials have been approved by the Office of Admissions.

Change of Program Declaration

Individuals who have been admitted to specific programs or to a college as undeclared students and who wish to change their designations of program or college admission may do so by notifying the Office of Admissions. Such changes of designation must reach the Office of Admission no later than one month prior to the date established for freshman registration and will be approved only if space in the desired program or college permits and the applicant has satisfied all admission requirements for the newly designated college or program. Changes in program designation after this deadline must be made after registration by filing requests for change of major and/or intercollegiate transfer within the University.

Application Procedures for International Students

Applicants who are residents of foreign countries are required to comply with those procedures specified above for graduating high-school seniors and are urged to have transcripts of their secondary school and/or college records, as well as all other application materials, submitted *in English no later than twelve months in advance* of their expected date of admission. All international students should have considerable facility in speaking and writing English and should have financial resources sufficient for their years of study at the University. Students whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL). Students are responsible for making arrangements for taking this test and should address inquiries to: TOEFL, Educational Testing Service, Princeton, New Jersey 08540, U.S.A. The completed application form should be

returned to the Testing Service at Princeton well in advance of the application deadline. The test fee, which should be remitted with the application, entitles the student to have his test score sent to three different institutions. Registration for the Test of English as a Foreign Language does not constitute application for admission to the University of Lowell. *The Bulletin of Information*, obtainable without charge, contains a description of the test as well as rules regarding application, fees, reports, and the conduct of the test; lists of examination centers, examination dates; and an application blank. On the application for the test, the student should specify that his score be sent to the Office of Admissions, University of Lowell, Lowell, Massachusetts 01854. In addition to the TOEFL, an admitted student may be required to report to the Admissions Office to make arrangements for taking an English placement test for foreign students prior to registration. Results of this test may determine the courses for which the student will be permitted to register in his or her program of study.

Application Procedures and Requirements for

Non-Graduates of High Schools

Applicants who have not graduated from high school may be admitted to the University upon satisfactory completion of the General Educational Development tests and receipt of a certificate of high-school equivalency. Such students are required to take the Scholastic Aptitude Tests of the College Entrance Examination Board prior to their application and to present scores which are acceptable to the University. Admissions procedures for students possessing certificates of high-school equivalency are the same as those which are prescribed for graduating seniors and high-school graduates.

Application Procedures and Requirements for Transfer Students

In general, the University of Lowell will accept on an hour-for-hour basis semester credits with grades of "C" (2.0 on a 4.0 scale) or better as shown on official transcripts of record which are received directly from other accredited collegiate institutions and which are applied to an initial baccalaureate degree. Quarter credits are recognized on a prorated basis of 3 quarter credits to 2 semester credits. Students who are interested in transferring credits for an additional baccalaureate degree should consult the appropriate section below concerning admission for an additional baccalaureate degree. Preference for admission to the University is based upon the record of each individual transfer applicant as to the end of the semester preceding admission. All credits to be transferred must be identified at the time of application for transfer, and under no circumstances will the University consider course work undertaken by the student prior to admission which is identified after transfer.

Students who transfer from four-year institutions must complete a minimum of 30 semester credits at the University of Lowell to be eligible for a Lowell baccalaureate degree. Students who transfer from two-year institutions must complete a minimum of 60 semester credits at the University of Lowell to be eligible for a Lowell baccalaureate degree. The University will not reduce the minimum 60 semester residency requirement for students who present more than 60 semester hours of junior college credit. This regulation applies both to students who transfer directly from two-year institutions and to students who have transferred more than 60 semester hours of junior college credit to another four-year institution and have subsequently transferred to the University of Lowell.

All transfer applicants must have completed an associate degree program or must be eligible to return to their last previously attended institution for the semester in which they seek admission to the University. A student who has been dismissed for academic or disciplinary reasons will not be considered for admission.

Required Credentials

It is the responsibility of students seeking transfer to the University for arranging with the institution in which their previous work was completed to forward to the Office of Admissions no later than May 1 for fall semester admissions of November 15 for spring semester admissions official transcripts of their completed courses and notations of all courses in progress. Additionally, final transcripts of all completed courses must be forwarded to the Office of Admissions following the completion of previously designated courses in progress. Unless applicants have made special arrangements with the registrars of their previous institutions to telephone grades for previously designated courses in progress to the Office of Admissions, their application files will be designated as

incomplete when they do not contain an official and final transcript. *Transfer students whose records are incomplete on the first day of semester classes may be prohibited from attending courses and may be required to withdraw from the University.* An applicant who has attended one or more institutions must request each registrar to mail directly to the Office of Admissions a transcript of his or her record even though credits were not earned or credits are not presented for transfer. An applicant who has fewer than 30 semester credits of acceptable courses, with grades of "C" (2.0 on a 4.0 scale) or better must request that his or her high school record and College Entrance Examination Board test scores be sent to the Office of Admissions.

Evaluation of Credentials

A preliminary evaluation of course credits to be transferred is made by the Office of Admissions at the time of application in accordance with general policies of the University. Students seeking transfer should be aware of the preliminary nature of this evaluation by the Office of Admissions and that the acceptance of the transfer course credit and the assignment of a year of graduation or other status is subject to final review by the student's major department when the student is formally accepted for matriculation by one of the Colleges of the University. *In all cases, transferred credit accepted by the University does not guarantee admissions to professional programs for which specific admissions standards and quotas have been established.* The Office of Admissions will advise applicants when their admission does not guarantee acceptance into their preferred professional programs. The applicability of grades received in transferred courses for the determination of the grade-point average of the student's major at the University of Lowell is determined by policies of each of the colleges.

University Restrictions

Courses completed at non-public institutions which are not accredited by the major regional accrediting associations will not be credited to degree programs of the University. Nor will courses be credited to baccalaureate programs of the University which were completed through extension or adult-enrichment programs (e.g., correspondence of home study) or post-secondary school diploma programs, which have been taken more than ten years prior to the date when a student applies for transfer, or which are unacceptable to the transfer institution for its associate or baccalaureate programs. However, such competencies as have been achieved by a student through courses which are unacceptable for transfer may be recognized by the University through procedures for advanced placement with course credit and through department examinations.

College and Program Restrictions

Many colleges and programs impose additional restrictions on the acceptability of transfer credit. The College of Education does not accept courses in curriculum and instruction, including apprentice teaching courses. The College of Health Professions has special regulations governing the acceptance of transfer credits for professional courses. Transfer applicants to the College of Health Professions should consult the dean of the college or the appropriate department chairperson on the transfer of these courses. The College of Liberal Arts will not accept in transfer professional courses from any program or curriculum whatsoever with the exception of courses credited to the degree program in the administration of Law and Justice. Students transferring to the College of Pure and Applied Science may transfer course credits in science and mathematics if these courses are equivalent to those specified by the curricula of the College. Prerequisites for courses in the major field within the College of Pure and Applied Science or courses which are prerequisites to admission to the College may not be credited to the minimum degree requirements in mathematics or the sciences. As a general rule, courses of a professional nature from any curriculum are not accepted in transfer when a student seeks admission to a different curriculum or program at the University of Lowell. Transfer applicants should consult the dean or departments for current regulations. Additionally, transfer applicants who enter the University in one program, or as undeclared students, may find that certain credits will be deleted from the record when they seek internal transfer to another college or program.

Retention Standards

For the purpose of determining academic standing, student records are reviewed each semester. Transfer students are initially evaluated *for retention purposes* at the end of the semester in which they have attempted their first 18

credits at the University. *Grade point averages for transfer students are computed solely on the basis of courses attempted at the University of Lowell. Grade point requirements are based on the total number of attempted course hours, which includes course hours attempted at the previous institution and those attempted at the University of Lowell.* For the table of grade point requirements for specific numbers of attempted course hours, refer to the section "Academic Standing," listed under Academic Policies in this bulletin.

The Massachusetts Transfer Compact

The University of Lowell has affirmed its intention to maintain flexibility in the transfer of qualified students of the Commonwealth of Massachusetts. For the implementation of this objective, the University of Lowell has subscribed to the Massachusetts Transfer Compact and applies to students who apply for admission under this compact the same policies which are applied to University of Lowell students who petition for intercollegiate transfer within the University.

All courses which have been accepted by the University from signatory community colleges of the Massachusetts Transfer Compact are listed on the student's permanent record card, and those courses which are not applicable to specific curriculum requirements are credited, whenever possible, as unrestricted elective courses. Since some curricula of the University do not provide for such unrestricted elective courses, or the number of transferred courses may exceed the number of unrestricted elective courses which are permitted within the specifications for minimum degree requirements, transferred courses which are not applicable to the specific requirements of a curriculum are not counted in the determination of the number of course hours completed until the semester of graduation. (Cf. regulations under the sub-heading "Academic Standing," which appears in the following chapter entitled "Undergraduate Academic Policies," for an explanation of course hours completed.) This procedure prevents the early imposition of a grade-point requirement for retention which is in excess of that specified for the number of credits completed and applicable to the student's particular curriculum.

Compact Specifications

Signatory institutions of higher education in the Commonwealth of Massachusetts will honor this policy and adhere to the following:

1. Definition of an associate degree transferable as a unit (contingent upon acceptance for admission) toward a baccalaureate degree as the equivalent of 60 hours of undergraduate college level study, including:
 - a. 6 hours of English/communication
 - b. 9 hours of behavioral/social sciences
 - c. 9 hours of humanities/fine arts
 - d. 9 hours of mathematics/sciences
 - e. the remaining credit to be on the college level
2. The awarding, upon acceptance, of the full number of credits earned while enrolled in the associate degree program.
3. Continuous review and evaluation of the implementation of this policy and referral to the Massachusetts Transfer Review Council of problems related to student mobility.

Clarifications

1. Students changing programs (e.g., liberal arts to engineering) may expect that it will require more than four semesters to complete the sequence of a new major.
2. "D" credit will be accepted toward the baccalaureate degree, but a receiving institution is required to apply "D" credit toward a major only if it does so for "native" students, that is, students who enrolled in the four-year institution as freshmen.
3. This unit transfer policy will accomplish the twin objectives of (1) providing unlimited opportunities for instructional and curricular flexibility in the two-year college sector, and (2) assigning to each two-year college full responsibility for meeting standards of equivalence for all programs submitted as transferable.
4. Course credit for transfers from programs not conforming to Compact specifications will be evaluated by the receiving institution according to the applicability of those courses to the baccalaureate program in the major field of the student.

Additional Baccalaureate Degree

A student who has earned a baccalaureate degree at the University of Lowell or at another accredited baccalaureate institution may be admitted to the University to pursue an additional baccalaureate degree subject to the following requirements: (1) the nomenclature of the additional degree to be pursued must be distinctly different from the previously conferred degree; e.g., Bachelor of Arts, Bachelor of Science, Bachelor of Music, Bachelor of Science in Engineering, Bachelor of Science in Business Administration, etc., (2) the major field of the previous degree must be clearly distinct from that of the additional degree, (3) the work for the additional degree must consist of not less than two semesters of residence, (4) the final 30 credits presented for the additional degree must be in addition to and independent of any previous baccalaureate, and (5) a minimum of 15 credits must be taken at the University in the major field which is presented for the additional degree. If any of the first

three years of credit has been transferred from another institution, the candidate for the additional baccalaureate degree must spend the last year earning a minimum of 30 credits of uninterrupted residence at the University.

Candidates for the additional baccalaureate must fulfill all curriculum requirements for the additional degree (including courses presented from previous programs and courses completed in fulfillment of the final 30 credit requirement) and must comply with any special college regulation concerning completion at the University of major field requirements. Students who are candidates for an additional baccalaureate may be eligible for major field honors but are not eligible for University honors unless they have completed 60 credits at the University following their admission as candidates for the additional baccalaureate degree.

Application for admission to the University as a candidate for an additional baccalaureate degree is made through the Office of Admissions. Prior to admission to the University as candidates for additional baccalaureate degrees, applicants must be approved by the college in which they plan to matriculate and the department in which they intend to major. Retention standards for candidates for additional baccalaureate degrees are based upon the grade-point averages for achieving satisfactory standing which are specified for the several levels of course hours completed. Grade-point averages are computed solely on the basis of qualitatively graded courses which have been completed at the University for the additional baccalaureate degree. The number of course hours completed include all course credits which have been applied from previous baccalaureate programs. (Cf. "Academic Standing," *infra*).

APPLICATION PROCEDURES FOR NON-MATRICULATING STUDENTS

Admission as a non-matriculating student is granted only within provisions which govern the non-degree programs cited below. Applicants for admission as non-matriculating students are required to file admission applications and to submit such credentials as are specified for their proposed non-degree programs. Readmission as a non-matriculated student may be granted when the following conditions are satisfied: (1) the student has satisfactorily completed his or her previously attempted courses, (2) the original condition under which he or she initiated non-matriculating studies permits continued enrollment, and (3) commitments of the University to matriculating students permit enrollment of non-matriculating students. Preference for admission as a non-matriculating student is granted by the Office of Admissions to individuals who qualify for the Educational Opportunities Program and the Second Chance Program for Adults.

Programs for Talented High-School Seniors

Under certain specified conditions, talented high-school seniors are permitted to enroll in the University as non-matriculating students. To qualify for such studies, high school seniors must be recommended by their principals as students who are sufficiently mature to complete their proposed courses of study. Each case of non-matriculating high school senior is considered individually on its own merits, and the Office of Admissions and the departments offering the courses desired by the student must concur with the high school principal's recommendation. Application for admission under the provisions of policies for non-matriculating high school seniors should be submitted to the Office of Admissions according to the schedule established specifically for this purpose. Grades and course credits will be recorded on the permanent record card of the student for all attempted course work in accordance with the grading system of the University and will appear on any official transcript issued to or for the student. In the event that non-matriculated high school seniors subsequently are granted matriculation status, their completed courses ("D" or better) will be credited to degree programs in accordance with regulations of the college to which they are admitted.

Second Chance Program for Adults

The Second Chance Program is a part-time plan of studies (three to eleven credits per semester) which is available to adults of both sexes with or without previous collegiate experience. Hence the program can provide an avenue to begin a program of higher education as well as to resume or to change a previously initiated program. The Program specifically has been instituted to meet the needs of three types of adults: (1) individuals whose desire to begin or to continue a higher education has been frustrated or interrupted by family or employment commitments, (2) individuals who may feel they are "too old" or "too out of practice" to compete full-time in the class-

room with recent high school graduates, and (3) individuals whose current employment makes impossible their attendance of evening programs of continuing education.

The only formal credential which is required for initial admission to the Second Chance Program is a high school diploma or certificate of high school equivalency. The program does not require the attainment of a specific high school average and does not specify the completion of any particular sequence of high school subjects. Nor does it require applicants to have completed Scholastic Aptitude Tests of the College Entrance Examination Board. The Second Chance Program is open to all adults on a space available basis, and through open admissions to a provisional program of 15 or 30 semester credits. It provides an alternative to the competitive admissions process for achieving matriculation status.

Admission to the Second Chance Program is not open to students of the University of Lowell with regular status, including students who have been granted reduced loads. Nor is the Second Chance Program available as an alternative admissions option for individuals who were previously enrolled in the University of Lowell as matriculating day students unless they have been absent from the University for two or more years prior to the date of their requested admission and have withdrawn from the University while in satisfactory academic standing.

Students who have completed 15 or more semester credits at an accredited college within the previous ten years are admitted to pursue a program of provisional studies of 15 semester credits. Students who have completed less than 15 credits at an accredited college within the previous ten years, or who have never attended an institution of higher education, are admitted to pursue a program of provisional studies of 30 semester credits. Second Chance students who satisfactorily complete their provisional programs are recommended by the program coordinator to the Office of Admissions for matriculation status and for general admission to colleges of the University as undeclared students or for specific admission to University programs as declared students. Students who achieve matriculation status and are admitted to a college are not required to decide upon a specific degree program until they have achieved sophomore standing (60 credits) but an immediate declaration of major will greatly facilitate the selection of appropriate prerequisite courses for major fields and accordingly will reduce the possibilities of making time-consuming errors in judgment.

Second Chance students who have satisfactorily completed their provisional programs and who wish to continue their studies on a part-time basis are permitted to petition for admission to all programs of the University *except Nursing and Education*. Students who wish to continue their studies on a full-time basis following completion of their provisional programs may do so and become regular, full-time University students. Such students also are permitted to petition for admission to the nursing program. Individuals should understand, however, that some programs have established admission requirements which mandate the completion of specific prerequisite courses and/or the achievement of higher grade-point averages than are specified by University retention standards for the achievement of matriculation status by Second Chance students. The program coordinator will advise an individual of these requirements when he or she has determined a choice of future curriculum and will assist in the development of a provisional program which will be relevant to such a curriculum.

Application Procedures

Individuals who are interested in the Second Chance Program should arrange an informal discussion with the program coordinator, Miss Joyce Denning, Coburn Hall, Room 201, extension 2479. If the Second Chance Program appears to suit an individual's needs, he or she should complete an application form in the office of Miss Denning, who will describe what is entailed by the several application requirements. Individuals who are interested in fall semester admission should arrange for an interview and must complete all application procedures on or before March 1st. Individuals who are interested in spring semester admission should arrange for an interview and must complete all application procedures on or before October 1st.

Admission to the University as a provisional, non-matriculating student in the Second Chance Program requires the completion of the following steps by the deadlines which are cited above: (1) complete the application form of the University of Lowell, (2) make payment of the application fee, (3) request high school principals to forward to the Second Chance office transcripts of secondary school grades or, for a student with high-school equivalency, request the Department of Education to forward to the Second Chance office certification of high school equivalency, and (4) request registrars of all institutions of higher education attended to forward transcripts of previous course work to the Second Chance office, whether such course work is presented for recognition or not. The responsibility for having all credentials forwarded to the Second Chance office rests solely with the applicant.

Following receipt of all admission materials, the program director will determine whether the student should be admitted for a 15 or 30 credit provisional period and may require an interview with students who have not previously discussed their plans or whose previous college course work justifies further discussion. Individuals who are accepted for admission must make a non-refundable tuition deposit of \$50.00. Receipt of this deposit is required by April 15th or November 15th for individuals to register during the designated fall or spring preregistration periods. Prior to registration during the preregistration or late registration period, an accepted applicant must file a notarized certificate of Massachusetts residency to qualify for in state tuition rates and the standard University health questionnaire.

Provisional Programs of Study

Provisional programs of study for individuals who have been admitted to the Second Chance Program with non-matriculation status are developed by the student in consultation with the program coordinator during periods for registration and preregistration. Appointments with the coordinator are scheduled well in advance for this purpose.

Qualification for Matriculation

Following satisfactory completion of their provisional program, individuals may be recommended for admission as matriculating students in one of the colleges of the University. Such recommendations will be made by the program coordinator. For this purpose, students are required to designate their type of University status (continued enrollment in the Second Chance Program with part-time status or enrollment as a regular student with full-time status) and their type of college admission (acceptance as undeclared students in a college or acceptance as declared students in a particular major or program). Students also are advised to designate a choice of alternative major or program when they have requested admission to programs which are regularly oversubscribed and/or for which waiting lists of applicants have been established.

Recommendations for matriculation are forwarded by the coordinator (together with transfer evaluation form and transcripts of all transfer and University courses) to the appropriate college dean and, subsequently, to the appropriate department chairperson if a designation of major has been made by the applicant. An individual is notified of his or her acceptance by the coordinator who will issue the student a formal letter of admission to a college and/or program to which he or she has been recommended. A student who is accepted for matriculation by one of the colleges of the University is assigned an advisor in the college of his or her admission and is no longer under the jurisdiction of the coordinator of the Second Chance Program.

Continued Matriculation in the Second Chance Program

Students who have been accepted for matriculation and who continue with part-time status in the Second Chance Program are required to present a minimum of 30 semester credits in University day classes and 15 credits of University courses in their majors. Upon the approval of the appropriate college dean, up to 15 credits of the minimum University residency requirement of 30 credits may be satisfied through completion of day courses in the University of Lowell Summer School (Cf. "Academic Policies: Residency Requirements.") Records of these students will carry the notation "SC" for the year of graduation as long as they maintain part-time status.

Tuition and Fees

Individuals who are enrolled as matriculated or non-matriculated students in the Second Chance Program are levied tuition fees in accordance with rates for part-time students and are required to pay all University fees when applicable to their programs except for the student activity and student union fees.

Programs for Students Matriculated at Other Colleges and Universities (Visiting Students)

Students who are matriculants for degrees at associate or baccalaureate institutions may be admitted to the University to pursue specifically authorized courses. Such students are admitted to the University on a semester-

by-semester basis and must secure prior approval for University courses from appropriate authorities at institutions where their degrees will be granted. Permission to enroll in courses of the University will not be granted to students without a letter from an appropriate officer of the institution in which they are matriculating which certifies that they are candidates for a degree and are in good academic standing. Courses of a professional nature may not be elected by non-matriculating students of the University unless specifically authorized by the appropriate college dean.

Programs for Students Matriculating in the Evening School of the University

Students who are matriculating for associate or baccalaureate degrees in the Evening School of Continuing Education may be permitted to pursue specifically authorized day courses. Such students must secure the written approval of their program coordinators for all projected courses prior to filing an application with the Office of Admissions. Full notation of approved courses (including those which have been failed) is made upon the permanent record card of continuing-education students.

Programs for University Employees

University employees who are high school graduates or who possess certificates of high school equivalency may apply for admission as non-matriculating students. Admission is extended to employees as non-matriculating students on a semester-by-semester basis and solely for courses designated at the time of application. Employees who wish to matriculate for a baccalaureate degree should apply for admission to the Second Chance Program for Adults. Participation in this program is subject to employee obligations and special policies of the Board of Trustees.

Programs for Students Holding Baccalaureate Degrees

An individual who holds a baccalaureate degree and who wishes to pursue a limited non-degree program (up to a maximum of 15 credits) may be admitted full or part-time to the University as a non-matriculating student. Such admission requires the approval of each of the departments in which courses are contemplated. University of Lowell graduates should indicate their dates of graduation on their application forms. Other applicants must request the registrars of the institutions in which their degrees were conferred to mail transcripts of their baccalaureate records directly to the Office of Admissions and are warned that permission to enroll in courses will be denied if transcripts have not been received prior to course registration. A student who holds a baccalaureate degree and who wishes to pursue a second baccalaureate degree must apply for admission as a matriculating student. A holder of a baccalaureate degree who does not wish to pursue a second baccalaureate should investigate the appropriateness of both degree and non-degree programs of the Graduate School before applying as a non-matriculating student.

EDUCATIONAL OPPORTUNITIES PROGRAM

The Educational Opportunities Program which is offered through the Office of Special Academic Services is a structured plan of non-matriculated studies for non-traditional students from various racial backgrounds and affords an alternative method for admission to such students who do not satisfy the regular admission requirements for degree studies because of inappropriate high school preparation for the college and curriculum of their choice, low achievement in high school or low scores in Scholastic Aptitude Tests. Students who are admitted to the University in this program are granted provisional non-matriculated status on a semester-by-semester basis and may remain enrolled in this program for a maximum period of four full-time semesters and two summer sessions. Continuous enrollment in the Educational Opportunities Program is permitted only for students who are recommended each semester for continuation by the Director of Special Academic Services. To qualify for continuation, individuals must have evidence sufficient academic promise to warrant predictions on continued success.

Potential participants in the Educational Opportunities Program are identified from the pool of University ap-

plicants by the staff of the Office of Admissions, who forward the names of such individuals to the Director of Special Academic Services. After reviewing the credentials of recommended applicants, the Director of Special Academic Services will arrange a personal interview with each individual who expresses an interest in the Educational Opportunities Program. Through personal interviews, academic assessment, school records, and recommendations from teachers, counselors, and other individuals who are personally acquainted with applicants, the Director seeks information concerning the nature and scope of each individual's interests and selects for admission those individuals whose potential and motivation for higher education indicate an acceptable probability of academic success.

Participants in the Educational Opportunities Program may be eligible for financial assistance through federal loans and grants (which may be arranged for a maximum of five years of combined enrollment in both the Educational Opportunities Program and a baccalaureate course of study), state programs, and University Program tuition remission. Although participating students in the Educational Opportunities Program have full access to dormitory housing, food services and University activities, they may not participate in varsity athletics, which are restricted to full-time matriculating students.

The Office of Special Academic Services assigns each participant a student preceptor and a faculty advisor to assist in the selection of a program of University courses and in the development of a plan of supplemental Special Academic Services courses. The objective of supplemental Special Academic Services courses is to develop those skills and habits which are fundamental to successful academic competition at the University of Lowell. Such courses are individualized and self-paced in nature and emphasize the development of study, note-taking, and test-taking skills and the mastery of the basic academic tools of reading, oral and written communication, computation, and mathematics. The comprehensive Educational Opportunities Program requires attendance for all activities. The Department of Special Academic Services also provides institutional environmental adjustment advising for program participants.

At the end of each semester of full-time enrollment (12 or more contact hours per week of University courses and supplemental Special Academic Services courses), the record of each participant is reviewed by the Director and a sub-committee of faculty members from the Special Academic Services Advisory Committee for the purpose of assessing individual progress and achievement. Participants whose progress is determined to be inadequate are dropped from the Educational Opportunities Program and are ineligible to pursue admission to colleges and degree programs of the University through this alternative admissions process.

Participants in the Educational Opportunities Program may qualify for admission as degree students at the end of any period of enrollment (including both semester and summer sessions) in which they have accumulated 15 credits of University courses with grades of "C" or better. In any event, all participants are required to have passed 30 credits of University courses by the end of their fourth semester of enrollment and to have achieved 15 credits with "C" grades or better. When applicable to the curriculum and college to which individuals apply, all University courses which have been passed with grades of "CD" or better will be recognized as matriculation credits and will be computed into subsequent grade-point averages. Supplemental Special Academic Services courses will not be recognized for credit. Nor will University courses which have been passed with grades of "D" be recognized for credit, and such courses must be repeated if they are required for programs to which individuals have been admitted. Individuals who do not achieve matriculation status by the end of their fourth semester of full-time enrollment are dropped from the Educational Opportunities Program and are ineligible to pursue admission to the University through this alternative means.

Since financial assistance through federal loan and grant programs may not be extended beyond a period of five years of undergraduate study, program participants who achieve matriculation status at the end of their fourth full-time semester are advised that financial assistance cannot be guaranteed for their full periods of baccalaureate studies unless they complete their degree program within the five-year limit for both EOP and degree studies.

Adult students from disadvantaged backgrounds who do not wish to pursue a full-time provisional program should inquire concerning their eligibility for admission to the part-time Second Chance Program for Adults.

ADVANCED PLACEMENT WITH COURSE CREDIT

Students entering the University as freshmen or as transfer students may elect to challenge courses through established procedures cited below. University departments reserve the right to refuse the granting of credit for

those examinations which are presented by a student for his or her major(s). Equivalency credit is granted for laboratory components of science courses only through examinations of University departments. Accordingly, science credits which are granted through the College Level Examination Program and Advanced Placement Examinations of the College Entrance Examination Board do not waive any specified laboratory requirement.

College Level Examination Program

General Examinations

Entering freshmen may be granted University credit for general examinations if they have achieved minimum designated scores. General examination credit is granted at the time of admission only

CLEP Examination	Maximum Semester Credits Authorized	Required Score
English Composition +	3	600
Mathematics	6	500
Natural Sciences#		500
Social Sciences@	6	500
Humanities@	6	500

+ A student who achieves a score of "600" or above satisfies the requirement for College Writing I.

*Credit may be granted only to students who matriculate for degrees in the College of Liberal Arts and the College of Music.

#Credit may be granted only to students who matriculate for degrees in the College of Liberal Arts, the College of Management Science, and the College of Music. Credit granted does *not* satisfy the specific laboratory course requirement of the revised University Core Requirements.

@Credit will not be granted for a general examination in an area which is cognate with a student's major. For example, credit for the general humanities examination will not be granted to students who major in art, English, languages, music, philosophy or other humanities areas. *Students who change major fields subsequent to receiving credit for general examinations are advised that previously granted credits are automatically nullified if their new majors are in an area in which general examination credit has been granted.*

Subject Examinations

Entering freshmen and transfer students may be granted university credit for subject examinations of the College Level Examination Program when they have achieved scores which are on or above the "C" grade level. A complete listing of subject examinations of CLEP for which the University grants credits may be found elsewhere in this publication under the heading "Academic Policies: Course Equivalency Examinations."

Advanced Placement Examinations of the College Entrance Examination Board

Entering freshmen who have demonstrated college level proficiency through Advanced Placement Examinations of the College Entrance Examination Board may be granted university credit for scores of "5," "4," and "3." Credit will not be given for scores of "2" or 1."

The following is a listing of Advanced Placement Examinations for which the University grants course credit.

AP Examination	Course Equivalent	Credit
American History	43-111, 112: (United States History)	6
Biology	83-101, 102 (Life Science)	6
Chemistry	84-121, 122 (Chemistry)	6
Classics-Vergil	56-303 (Selected Latin Authors)	3
Classics-Latin lyric	56-303 (Selected Latin Authors)	3
English	42-101 (College Writing)	3*
European History	43-219, 220 (Europe)	6
French Language	50-246, 248 (Advanced Conversation & Composition)	6
French Literature	50-261, 262 (Literature of Ideas & Selected Writings)	6
German Literature	51-491 (German Literature)	6

Mathematics: Calculus AB	92-133, 134 (Calculus A I & II)	8
Mathematics: Calculus BC	92-133, 134 (Calculus A I & II)	8
Music	74-161 (Music of Western Civilization)	3
Physics B	95-103, 014 (General Physics)	6
Physics C — Mechanics	95-141 (Physics I)	3
Physics C — Electricity & Magnetism	95-245 (Physics III)	3
Spanish Literature	54-302, 303 (Introduction to Spanish & Latin American Literature)	6

*An additional 3 credits may be granted to students for 42-102 (College Writing and Literature) upon successful completion of the exemption examination of the Department of English.

Foreign Language Achievement Tests of the College Entrance Examination Board

University credit is granted upon the recommendation of the Department of Languages to entering freshmen who have demonstrated satisfactory language competency through the Language Achievement Tests of the College Entrance Examination Board. University credit on the intermediate course level will be given to students achieving scores of "550" or better. Such credit will satisfy any language proficiency requirement specified for students by their major departments.

Foreign Language Achievement Tests Administered by the Department of Languages

University credit is granted to entering freshmen and transfer students who have demonstrated satisfactory language competency through reading examinations in foreign languages which have been administered by the Department of Languages. College credit on the intermediate level will be given to students achieving satisfactory scores in tests of foreign languages which are offered by the University of Lowell. Such credit will satisfy any language proficiency requirement specified for students by their major departments.

Course Credit Limits Through Advanced Placement with Credit

The maximum number of credits which may be granted to any student through advanced placement procedures, including departmental equivalency examinations, is 42 semester credits. Under no circumstances will duplicating examination credit be granted to students who present formal course work for transfer. Nor will examination credit be granted to transferring students for the purposes of reducing either the major field residency requirement of 15 credits or the general residency requirement of 30 credits in University day courses.

READMISSION PROCEDURES FOR PREVIOUSLY MATRICULATED STUDENTS

Reinstatement

The University does not grant leaves of absence to students who wish to interrupt their baccalaureate studies. Accordingly, students who have withdrawn from the University and who seek readmission must file an application for readmission with the Office of Admissions. Upper division students in the College of Health Professions must make individual arrangements with appropriate chairpersons to reserve their spaces in courses for the semester of their anticipated return to the University. Unless such special arrangements have been made, reinstatement by the Office of Admissions cannot ensure full resumption of a student's course of study. When resources of a college or program render it necessary to establish limitations upon enrollments, the Office of Admissions will establish a waiting list of applicants for transfer and reinstatement. Differential admissions criteria above and beyond minimum program requirements may be applied to these individuals to ensure the admission and readmission of the most qualified applicants for the limited openings.

In the event that readmission applicants wish to change their programs and/or to seek readmission to the University in a college other than that which they previously attended, their reinstatement must be approved by the chairperson of the program to which they seek admission and the appropriate college dean. If program enrollments permit, approval for such readmission will be granted to students who satisfy all program admission requirements. Individuals who seek readmission to the University in a college other than that which they previously attended will be subject to reevaluation procedures which are specified for enrolled students who seek an intercollegiate transfer. (CF. policies governing intercollegiate transfer which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer.") Individuals who apply for intercollegiate transfer must submit their applications no later than *November 1 for spring semester reinstatement and April 1 for fall semester reinstatement*.

Unqualified Reinstatement

Individuals who prior to their withdrawal were students in satisfactory academic standing and who have not been absent from the University for more than one semester are automatically reinstated to the programs in which they were previously enrolled and are subject to curriculum requirements which are in effect for the classes to which they previously belonged. Application for readmission must be filed with the Office of Admissions.

Qualified Reinstatement

Students who have been absent from the University for two or more continuous semesters are subject to the rules and regulations of the University which are in effect at the time of their readmission rather than at the time of their original admission. If program enrollments permit, individuals who were students in satisfactory academic standing prior to their withdrawal ordinarily are reinstated to the programs in which they were previously enrolled. However, during an individual's absence some programs may have established higher entrance and retention requirements and he or she may be denied reinstatement for failure to satisfy these requirements.

Individuals are not automatically reinstated to the programs in which they were previously enrolled when they have been absent from the University for periods exceeding ten years. Course work which has been completed prior to ten years of the date of readmission is generally recognized only through those examination procedures described in the policy statements for course equivalency. Such course work may also be evaluated on an individual basis by the Academic Standards Committee of the college in which an applicant desires to reestablish his or her matriculation. Students who wish to have such course work evaluated by the Committee must present their cases in writing to the Committee no later than *November 1 for spring semester readmission and April 1 for fall semester readmission*. Such students who wish to reestablish their matriculation on a part-time basis should consider the Second Chance Program for Adults.

Individuals who have been suspended from the University for unsatisfactory academic standing may apply for readmission only within policies which govern probationary readmission.

Probationary Readmission

A student who has been suspended from the University is entitled to apply for readmission as a full-time probationary student but may not initiate his or her probationary studies before an absence from the University of one semester. Application for such readmission to all programs except continuing-education curricula is made through the Office of Admissions and must be received by *April 1 for a readmission decision during the spring semester and by November 1 for a readmission decision during the fall semester*. Petitions which have been received by the filing deadline of November 1 will be reviewed by the appropriate academic standards committee during the fall semester, and readmitted students will be permitted to initiate their probationary studies at the beginning of the spring semester. Similarly, petitions which have been received by the filing deadline of April 1 will be reviewed by the appropriate academic standards committee during the spring semester, and readmitted students will be permitted to initiate their probationary studies at the beginning of the fall semester. *Probationary studies may be authorized during the fall and spring semesters and in day classes only.*

Upon the receipt of an application, the Office of Admissions will forward all readmission papers to the academic standards committee of the college to which the student applies. Except as prohibited by the academic policies of professional colleges, suspended students may petition for readmission to the University with probationary status

as follows. (1) All suspended students may petition for readmission to the college in which they were previously enrolled and may request reenrollment in the former major or readmission with a change of major. (2) Freshmen students and sophomore students who have attempted a maximum of 45 credits or three full-time semesters also may petition simultaneously for intercollegiate transfer and for probationary admission to a new program. Students who have attempted 45 credits or three full-time semesters are not eligible for intercollegiate transfer at the time of probationary readmission.

Students who are readmitted to colleges from which they were previously suspended must achieve satisfactory academic standing for all course hours completed by the end of their probationary semester. Students who are permitted to make an intercollegiate transfer will be permitted to transfer all applicable courses which have been completed with grades of "C" or better and will be required to attain a probation average of 2.00 in order to achieve satisfactory academic standing.

After securing recommendations from appropriate departments and studying the previous academic record of the student, the academic standards committee will lay down the requirements which the student must satisfy as a condition for his or her probation (specific courses to be taken, conference schedules with faculty advisors, and any other special or general academic condition which may be construed as necessary for the student's successful completion of his or her probationary studies). In determining such requirements for probation, the academic standards committees shall prescribe a sufficient number of courses for a student who has been readmitted to a college from which he or she has been suspended, which shall make the achievement of satisfactory academic standing reasonably possible during a full-time semester of probation. For complete information concerning probationary requirements, cf. "Undergraduate Academic Policies: Academic Standing."

PHYSICAL EXAMINATION REQUIREMENTS

Each new student is required to present evidence of satisfactory physical and mental health to the Health Service Office. Each admitted applicant for admission will receive a student health-report form which must be used to report pertinent medical data to the Health Service Office. Upon the advice of a Health Service physician, the admission, readmission, or continuing registration of a student may be denied until the student is cleared by the Health Service Office. Military personnel may have their student health report forms completed by a base physician.

All new freshmen, transfer, and readmitted students are required to present evidence of freedom from tuberculosis by means of clinical testing or chest x-ray and to file appropriate documentation of such evidence with the Health Service Office.

All entering students must provide the following evidence *before* beginning classes:

(1) Recent Mantoux Tuberculin Test, (*Tine Test not acceptable*) (2) Physical examination and Health History Questionnaire; (3) Record of childhood illness or immunization for measles, mumps and polio; (4) Record of Rubella immunization or Rubella Titer; and (5) Medical release form if under 18 years of age.

FINANCIAL, HOUSING, AND STUDENT SERVICES INFORMATION

University related costs (tuition, fees, housing, board, books, and special uniform expenses) for Massachusetts citizens who reside on campus are approximately \$3,800.00. Similar expenses for out-of-state students are \$5,900.00. Additional costs for which the student should plan in estimating his or her total expenses include clothing, transportation, and entertainment. Expenditures for books and instructional supplies vary considerably, depending upon the student's major subject, but a conservative estimate for such expenditures is \$800.00. Official University charges noted below and in the following sections concerning Food Services and Student Housing were in effect at the beginning of the 1982-1983 academic year and are subject to change without prior notice by the Board of Regents of Higher Education or the Board of Trustees of the University of Lowell.

UNIVERSITY CHARGES

Tuition Fees

Full-time Tuition (residents of Massachusetts)	\$ 986.00/yr.
Full-time Tuition (non-residents of Massachusetts)	3,242.00/yr.
Special student Tuition (residents of Massachusetts)*	41.50/credit
Special student Tuition (non-residents of Massachusetts)*	135.50/credit

University Fees

Academic Service Fee \$2.00/semester credit to a maximum of \$30.00/semester	\$ 60.00/yr.
Application Fee (residents of Massachusetts)	18.00
Application Fee (non-residents of Massachusetts)	25.00
Applied Music Fee:	
Effective September 1982	50.00
Effective January 1983	100.00
Effective September 1983 and thereafter	137.50
Athletic Fee	59.55
Audit Fee (per contact hour for part-time students)	Not set
Change of Course Fee (per course change transaction)	5.00
Clinical Supervision Fee	12.00
Commencement Fee	30.00
Laboratory Fee (per studio or laboratory course)	25.00
Late Registration Fee	20.00
Orientation Fee (Freshman)	35.00
Orientation Fee (Transfers and Reinstates)	25.00
Student Activity Fee (Freshman full-time students)	70.45
Student Activity Fee (Upperclass full-time students)	67.50
Student Union Fee (full-time students only)	50.00
Transcript Fee (after three transcripts)	1.00

*Special student tuition fees are not applicable to full-time students who have been granted "reduced load status."

Living Expenses

Dormitory Charge	\$1,000.00/yr.
Dormitory Damage Deposit Fee	50.00
Energy surcharge (dormitory students only)	58.00
Meal Plan (Plan A)	1,365.92/yr.
Meal Plan (Plan B)	1,271.30/yr.

Student Insurance

Accident Insurance (Covered for full-time students by Activity Fee)

Optional Major Medical Insurance

Single Students

82.50

Student and Spouse

192.50

Student, Spouse, and Dependent Children

308.00

EXPLANATION OF UNIVERSITY CHARGES

Tuition Rates

The Board of Regents establishes tuition rates on the basis of official state residency. Eligibility for in-state tuition rates is determined by regulations governing Massachusetts residency and the New England Regional Student Program, the details of which are provided below.

Academic Service Fee

This fee is established to support the delivery of academic services to the student body by the computer and library services. Expenditures are made for the maintenance and repair of equipment, the cost of expendable supplies, etc.

Application Fee

State law requires institutions of public higher education to collect specified application fees. These fees are not refundable and are not applicable to tuition.

Applied Music Fee

This fee is charged to undergraduate students who take applied music courses and in part, covers the cost of individual lessons and special ensemble instruction.

Athletic Fee

This fee is for the support of varsity athletics, intramural athletics and their associated expenses.

Audit Fee

This fee, levied for part-time students only, is determined by the number of contact hours for which an audited course is scheduled. Fees for courses which include both lecture and laboratory hours are levied for lecture hours only since laboratory hours may not be audited.

Change of Course Fee

This fee is assessed when students initiate a course change; a fee of \$5.00 is charged for *each change, that is, for each add, each drop, each section change*. No fee is charged for a change in a student program which is the result of University action. The appropriate college dean may waive the fee in those cases for which, in his or her opinion, sufficient and/or compelling reasons exist.

Clinical Supervision Fee

This fee is charged those students who are placed in clinical agencies, including schools, to defray the costs of supervision by University faculty and expenses which are incurred by personnel of cooperating agencies and schools. The fee is collected for each clinical experience for which the student has contracted.

Commencement Fee

This charge is assessed in September of the student's senior year and helps to defray the costs of graduation exercises. Students who desire to graduate "in absentia" may not be granted a waiver of this fee.

Laboratory Fee

Most science courses and some law and justice, music, nursing, physical therapy, psychology, and art studio courses require the payment of this special fee.

Late Fee

Students who fail to register prior to the late registration period or to make payment of their charges by the date specified on their semester bills are required to pay this fee.

Orientation Fee

Charged to defray some costs, such as meals, counseling, student guides, printed materials and other activities during the orientation period for new students.

Student Activity Fee

This fee, required of full-time students only, supports an extensive and varied range of athletic, cultural, and social activities for students. In addition, payment entitles each student to admission to many campus events and includes a subscription to the campus newspaper, the yearbook, and accident insurance.

Student Union Fee

Funds derived from this fee, which is levied upon full-time students only, are used to support the Student Union and to meet the operating costs of various student activities.

Transcript Fee

Students are issued three transcripts of their permanent academic record cards without charge. A fee of \$1.00 is charged for the fourth transcript and for each additional transcript thereafter.

Dormitory Charge

A charge for residence in the dormitory and use of dormitory facilities.

Dormitory Damage Deposit Fee

Charged to all dormitory residents. If damage occurs, the student is charged for the damage less the deposit paid. If damage charges are not assessed the deposit will be refunded at the end of the academic year.

Energy Surcharge

Assessed on dormitory students to assist in defraying the costs of heat, light, hot water.

Insurance

The University of Lowell automatically provides all full-time students with accident coverage through the student activities fee. When injury shall require treatment by a legally qualified physician or surgeon, dental treatment to sound, natural teeth, confinement within a hospital, use of ambulance or employment of a graduate or licensed nurse, the accident insurance coverage will pay the expense actually incurred by the student within 52 weeks after the date of the accident for such treatment, hospital confinement, ambulance and nurse expense up to an aggregate amount not to exceed \$1,000. Additional coverage for sickness major medical benefits and special coverage for mental and nervous disorders and alcoholism is provided by the optional insurance plan. A family plan for married students is also available with options for coverage of spouses only or spouses and dependent children. Details concerning coverage provided by the student medical plan may be secured from the Office of Student Affairs, Cummock Hall (North Campus).

TUITION WAIVERS FOR MASSACHUSETTS SENIOR CITIZENS

Citizens of Massachusetts age 60 and over are entitled to free tuition at the University on a space available basis. Applicable fees, costs of instructional materials (books, etc.), and tuition for short-term intensive workshops or seminars are not covered by this waiver. Senior citizens who are admitted as matriculating students must satisfy established admission requirements for programs or must qualify for admission to the University through the Second Chance Program for Adults.

PAYMENT OF BILLS

Students will be permitted to attend classes and use University facilities only after they have cleared their financial obligations (including the payment of library fines) or have made satisfactory arrangements for payment. All bills are payable in advance by check or money order and are due as specified on billing statements. Checks or money orders for payment of fees and tuition must be made payable to the University of Lowell. Checks for the meal fee must be made payable to the University of Lowell Cafeteria Account.

A student in debt to the University at the end of any semester or summer session for fees or other charges is not permitted to register again at the University until his or her indebtedness has been discharged. Such a student who has been preregistered shall have his or her registration cancelled without further notice if payment of previous indebtedness has not been made one month prior to the beginning of classes for the following semester. Grade reports of non-matriculating students will not be released unless all indebtedness has been discharged.

REFUND POLICY

A full-time student who withdraws from the University before the beginning of the fifth week will be granted a pro-rata refund of tuition upon application to the Office of the Bursar. The date of official academic withdrawal as recorded by the Office of the Registrar is the primary basis of any claim for tuition refund but such refund also may be authorized for documented reasons of an extraordinary nature which are acceptable to the Bursar. A student who makes an advance payment and then for any reason does not attend any part of the next semester or term at the University, *and who so notifies the Office of the Registrar within the first ten days of a semester*, will be given a full refund of tuition and fees. The special application fee is not refundable. Refunds of tuition charges and dormitory rental fees are granted to full-time students (including applicants for full-time status) in accordance with the following schedule:

Before the beginning of the second week	80% refund
From the second week but before the third week	60% refund
From the third week but before the fourth week	40% refund
From the fourth week but before the fifth week	20% refund
From the fifth week on	No refund

RULES GOVERNING MASSACHUSETTS RESIDENCY

These rules and regulations shall apply to the classification of students at the University of Lowell as Massachusetts or non-Massachusetts students for tuition purposes.

Definitions

(1) **ACADEMIC PERIOD** - A term or semester in an academic year or a summer session, as prescribed by the Board of Trustees or under their authority.

(2) **CONTINUOUS ATTENDANCE** - Enrollment at the University for the normal academic year in each calendar year, or the appropriate portion or portions of such academic year as prescribed by the Board of Trustees or under their authority.

(3) **DOMICILE** - A person's true, fixed and permanent home and place of habitation, where he or she intends to remain permanently or for an indefinite time.

(4) **EMANCIPATED PERSON** - A person (a) who has attained the age of 18 years, or (b) if under 18 years of age, whose parents have entirely surrendered the right to the care, custody and earnings of such person and who no longer are under any legal obligation to support or maintain such person, or (c) a person who has no parent. If none of the aforesaid definitions apply, said person shall be deemed an "unemancipated person."

(5) **PARENT** - With respect to a person (in the case of an adopted person, inserting the adjective "adoptive" before the words "father" or "mother" wherever used):

(a) the person's father;

(b) if the person's father dies, either the legal guardian or if no legal guardian is appointed, the person's mother;

(c) if neither the father nor mother is living and no legal guardian is appointed, the person who then stands **in loco parentis** to the person;

(d) if the father and mother are divorced, separated or unmarried and legal custody has not been awarded, the father or the mother, as the case may be, with whom the person lives or, if he lives with neither and the father is living, the father.

(6) **RESIDENCE** - A place of habitation.

Rules for Determination of Domicile

(1) Domicile is not acquired by mere physical presence in Massachusetts while the person is carrying on a course of study at the University or while the person is engaged in employment for a specified term unless Massachusetts is otherwise the domicile of the person.

(2) Domicile at birth may be changed thereafter, by action of the parent in the case of an unemancipated person or by action of the person himself in the case of an emancipated person.

(3) A person claiming Massachusetts as his domicile shall furnish evidence to support such claim. The burden of proof in all cases is upon the person making the claim. The following shall be of probative value, although not necessarily conclusive, in support of a claim of domicile within Massachusetts:

- (a) Birth certificate;
- (b) Motor vehicle registration and/or operator's license;
- (c) Voting or registration for voting;
- (d) Certified copies of Federal and State Income Tax returns;
- (e) Property ownership;
- (f) Continuous physical presence in Massachusetts during periods when not enrolled as a student;
- (g) Permanent employment in a position not normally filled by a student;
- (h) Reliance on Massachusetts sources for financial support;
- (i) Former domicile in Massachusetts and maintenance of significant connections therein while absent;
- (j) Domicile of parent within Massachusetts.

Evidence submitted in support of an assertion of domicile or of parental relationship shall be in such form as the President of the University or his designee may require. Copies of official records or documents shall be authenticated by a proper officer. Assertions of fact made other than by an authenticated copy of an official record shall be certified as to accuracy and completeness by the person submitting the same.

Proof of Parental Relationship

A person asserting that he or she is an emancipated person shall furnish evidence to support such assertion. Such evidence may include:

- (a) Birth certificate or any other legal document that shows place and date of birth;
- (b) Legal guardianship papers - court appointment and termination must be submitted;
- (c) Statements of the person, his parent(s), guardian(s), or others certifying no financial support;
- (d) Certified copies of Federal and State Income Tax returns filed by the person and his or her parent(s);
- (e) Where none of the foregoing can be provided, an affidavit of the emancipated person in explanation thereof and stating fully the grounds supporting the claim of emancipation.

Rules for Classification

(1) Every emancipated person applying for admission to the University who has maintained a residence in Massachusetts for a period of not less than twelve continuous months next preceding the date of his or her application and has established a domicile in Massachusetts shall be eligible for classification as a Massachusetts student for tuition purposes.

(2) Every unemancipated person applying for admission to the University, whose parent has maintained a residence in Massachusetts for a period of not less than one continuous calendar year next preceding the date of application and has established a domicile in Massachusetts, shall be eligible for classification as a Massachusetts student for tuition purposes.

(3) Every emancipated person seeking a change in classification who has maintained a residence in Massachusetts for a period of not less than one continuous calendar year next preceding the beginning date of the academic period for which he or she registers and has established a domicile in Massachusetts shall be eligible for classification as a Massachusetts student for tuition purposes for such academic period.

(4) Every unemancipated person seeking a change in classification, whose parent has maintained a residence in Massachusetts for a period of not less than one continuous calendar year next preceding the beginning date of the academic period for which the person registers and has established a domicile in Massachusetts, shall be eligible for classification as a Massachusetts student for tuition purposes for such academic period.

(5) A person having his or her domicile elsewhere than Massachusetts shall not be eligible for classification as a Massachusetts student for tuition purposes except as herein provided.

(6) Any person who is registered at the University as a Massachusetts student shall be eligible for continued classification as a Massachusetts student for tuition purposes (until attainment of the degree for which he or she is then enrolled) during continuous attendance at such institution.

(7) A member of the Armed Forces of the United States and his spouse and unemancipated children shall, while he or she is on active duty and stationed in the Commonwealth of Massachusetts, be eligible for classification as Massachusetts students for tuition purposes.

(8) A citizen of any other country other than the United States who is in this country on a permanent immigration visa can be classified as a Massachusetts student for tuition purposes if he or she has been domiciled in the state for a period of not less than one calendar year next preceding the beginning date of the academic period for which he or she registered under circumstances indicating his or her intention to reside permanently in Massachusetts.

Change of Classification

No application for change to classification as a Massachusetts student for tuition purposes submitted later than the first day of classes shall affect a classification during the then current academic period.

Penalty for Misrepresentation

Misrepresentation in or omission from any evidence submitted of any fact which if correctly or completely stated would be grounds to deny classification as a Massachusetts student for tuition purposes shall be cause for exclusion or expulsion from or other disciplinary action by the University.

Appeals

Appeal from a determination denying classification as a Massachusetts student shall be initiated by filing a written request with the President of the University or his designee specifying the particular grounds for said request.

Authority of Board of Trustees

Nothing contained herein shall be construed as limiting or prohibiting the authority of the Board of Trustees to waive or reduce tuition charges.

NEW ENGLAND REGIONAL STUDENT PROGRAM

Students who meet the eligibility requirements for residents of their state and admission requirements of a University program approved as a regional curriculum will receive preference in admission among out-of-state applicants and will be charged the in-state tuition upon admission. It is assumed that students accepted into a program of study offered under the New England Regional Student Program will remain in the same field of study. If a student transfers into a program which is not included in the Regional Student Program, out-of-state tuition will be applicable as of the date of transfer.

The following is a listing of programs of the University of Lowell which are offered under the New England Regional Student Program.

Lowell Program

Environmental Science
Health Education
Industrial Technology
Meteorology
Nuclear Engineering
Plastics Engineering
Radiological Health Physics

Eligible States

Connecticut, Maine, Rhode Island
Rhode Island, Vermont
Connecticut, Rhode Island
All New England States
All New England States
All New England States
All New England States

FINANCIAL AID

Financial aid consists of scholarships and grants (the awarding of money for which no payment is required), self help in the form of loans (money lent to a student to be paid during a specified period, usually following the termination of University studies) and employment (government or University sponsored work for all or part of an academic year). Awards are made on a yearly basis and are dependent upon the availability of funding from specific sources, proven financial need, and the criteria of specific financial aid sources. **ALL CANDIDATES FOR FINANCIAL AID MUST SUBMIT TO THE FINANCIAL AID OFFICE A COPY OF THEIR PARENT'S 1040, AS WELL AS THEIR OWN.**

UNIVERSITY ADMINISTERED FEDERAL ASSISTANCE PROGRAMS

At the University of Lowell financial aid is available to students who are citizens of the United States or who have permanent visa status. Aid is granted for the fall and spring semesters, and in some instances, for summer sessions. In order to qualify for financial aid, all incoming and transfer students must file a Financial Aid Form, or if a resident of Massachusetts, a Massachusetts Financial Aid Form. These completed forms must be mailed directly to the College Scholarship Service at the address listed on the front of the Financial Aid Form. The University also requires all candidates for financial assistance to complete a University form and file it with the Financial Aid Office. Copies of these required forms may be secured by writing to the Office of Financial Aid, University of Lowell (South Campus), Lowell, Massachusetts 01854.

Pell Grant

It is the policy of the University of Lowell that all students in need of financial assistance **MUST** file for the Pell Grant Program since the criteria of this program are the bases for determining student need. All students, except those who have received a baccalaureate degree, are eligible to apply. Applications for these grants may be obtained from high school guidance offices, the Office of Financial Aid, federal post offices, and public libraries. Amount of grant will be dependent upon funding available and may vary from year to year.

Supplemental Education Opportunity Grant

In conjunction with other forms of financial aid, supplemental grants provide assistance to students of exceptional financial need who would not otherwise be able to consider a college education without attendant indebtedness which would seriously impair future careers.

College Work Study Program

Under the work-study program, a student who meets established financial aid criteria can be assigned part time employment on campus. Student may work 15 hours per week while attending classes full time and may be employed up to 40 hours per week during vacation and summer periods.

Job Locator Program

This program offers part time and summer employment for students with or without financial aid. It is available to provide off-campus jobs. Often students are able to find placement in their field of interest.

National Direct Student Loans

A student may borrow up to \$1,500 per year under this program. Interest, at 5% per year (subject to change) begins 6 months after graduation or withdrawal from the University. The loan is to be repaid within 10 years. To be eligible, students must be American citizens or permanent residents of the United States, must be accepted for admission or already enrolled and in good standing in the University, and have demonstrated financial need. Eligible students should not assume that they will receive a National Direct Student Loan since available funds are inadequate to meet the needs of all qualified applicants. The average National Direct Student Loan is between \$300 and \$600.

Nursing Student Loan Program

The nursing student loan program assists needy students who need financial assistance to pursue a course of study in nursing. The goal is to increase the opportunities for youth seeking careers in nursing by providing long-term, low interest loans. Repayment begins 9 months after separation from the University unless military service intervenes, in which case repayment is postponed until 9 months after the termination of such service. Simple interest of 6% per year is charged and repayment must be completed within 10 years following graduation or withdrawal from the University. In addition, there are cancellation privileges for nursing graduates who enter into agreement with the Secretary of the Department of Education to practice for at least 2 years in areas specified by the Secretary to be areas of dire need.

MASS. HIGHER EDUCATION STUDENT LOAN PROGRAM

Massachusetts Higher Education Assistance Corporation (MASS-HELP) is a private non-profit corporation whose purpose is to assist students in financing higher education and vocational training. One type of assistance is called the Higher Education Loan Plan or HELP for short. A HELP Loan is a low interest bank loan available to students for educational expenses. The student pays no interest until 6 or 9 months after leaving school, and then has up to 10 years to repay the loan. MASS-HELP guarantees payment of the loan so the banks are willing to lend money to students who have no collateral or established credit standing. As undergraduate student can borrow up to \$2,500 for each school year to a maximum of \$12,500 for the undergraduate program. A graduate student can borrow up to \$5,000 for each school year but not more than a total of \$25,000 for graduate and undergraduate loans combined. You can only borrow the cost of your education less other sources of financial aid, veteran's and social security benefits, and in certain cases an amount which your family is expected to contribute for your education. The interest rate on a HELP loan is 9% (subject to change). The federal government will pay the interest for you while you are attending school. For further information contact Massachusetts Higher Education Assistance Corporation, Berkeley Place at 330 Stuart St., Boston, Mass. 02116. Tel (617) 426-9796.

EMERGENCY LOANS

Limited, short-term loans are made to students by the Dean of Students to cover unexpected personal emergencies. These loans are to be repaid at a time specified by the loan note, which a student must sign at the time an emergency loan is granted.

BOOKSTORE LOANS

Students may apply for Bookstore Loans through the University of Lowell Associates, Inc. The maximum amount which can be borrowed by a student over the four-year undergraduate period is \$500. Repayments made while the student is enrolled in the University are interest free. On those loans which are not repaid until after graduation or withdrawal there is an interest charge at 4% per year beginning 3 months after termination of enrollment. Repayments become mandatory at the rate of \$10. per quarter, plus interest, until the loan is repaid. Additional or complete repayment is accepted at any time (Applicants must submit a financial aid form to the College Scholarship Service, Princeton, New Jersey).

SCHOLARSHIPS

Mass. Board of Regents of Higher Education

The Board of Regents of Higher Education awards scholarships to qualified residents of Mass. on the basis of academic promise and demonstrated financial need. Application for these scholarships must be made on the Massachusetts Financial Aid Form. New applicants should consult their high school guidance counselors for filing deadlines.

Commonwealth of Massachusetts Scholarships

Twenty tuition scholarships are available to residents of the Commonwealth who are enrolled in the freshman class at the University. Awards are made on the basis of combined SAT scores and demonstrated financial need. These scholarships are renewable subject to satisfactory academic standing in the University.

City of Lowell Scholarships

The City of Lowell supports 18 annual scholarships to the University for entering freshmen, 10 of which are reserved for students who have been admitted to the nursing program. These scholarships, for qualified residents only, provide \$300 during the 8 semester undergraduate period. Nursing scholarship recipients who transfer to other majors or who fail to maintain satisfactory academic standing, forfeit their scholarships. Application forms for City of Lowell scholarships may be secured in the guidance office of Lowell High School or the University Financial Aid Office.

Federal Nursing Scholarship Program

This program, which provides scholarship assistance to students pursuing careers in nursing, is awarded by the Financial Aid Office, contingent upon receipt of federal funding. Additional details (requirements, amounts available to applicants, the number of recipients, etc.) may be secured from the Financial Aid Office.

University Scholarships and Awards

The University of Lowell has endowed scholarship funds to assist students who satisfy qualification requirements designated by the donors. Upperclassmen are requested to check with their Department chairman for further details.

SCHOLARSHIPS AND AWARDS PRIMARILY FOR UNDERCLASSMEN:

Alumni Association Scholarships:

Scholarships to assist with tuition and/or miscellaneous fees and are renewable provided satisfactory academic standing is maintained. Matriculating students are eligible to apply.

American Society for Medical-Technology Education and Research Fund:

This scholarship is made available through the Fisher Scientific Company to full time Clinical Lab Sciences students who have completed at least the first semester of their sophomore year and is awarded for completion of both the junior and senior years.

Roland E. Derby Memorial Scholarship:

This scholarship, established in the memory of Roland E. Derby, Sr., provides a \$500 scholarship to 2 sophomore students and is limited to students pursuing degrees in chemistry or chemical engineering. Recipients are selected by the Departmental Scholarship Committee on the basis of scholastic achievement with due consideration being given for financial need. Scholarships may be renewed for the junior and senior years provided satisfactory academic records are maintained.

Eastman Kodak Undergraduate Scholarship:

This scholarship is granted to University departments from which certain employees of Eastman Kodak have graduated and is awarded in accordance with departmental policies. See your department chairman.

Genradco Trust Scholarship Fund:

Scholarships are awarded from this scholarship fund to the highest ranking female and male student in each of the 3 upperclasses, and are restricted to students majoring in industrial technology.

Barnett D. Gordon Award:

The award is made to an incoming freshman who has achieved the highest score in the mathematics examination of the Scholastic Aptitude Test.

Honeywell Fund Scholarship:

A generous gift from Honeywell is to be utilized as follows: 3/4 to be awarded to students solely on the basis of need and 1/4 to be awarded to upperclassmen in the field of electro-optics.

Lowell Sun Charities Scholarship Fund:

This fund, established by the Lowell Sun Charities provides scholarships, renewed annually, for greater Lowell residents. Recipients must demonstrate good moral character as well as high academic standing.

Rosemary Peirent Scholarship Award:

Reserved for an incoming freshman graduating from Tewksbury Memorial High School. Check your school guidance office.

Mark Wagner Memorial Scholarship:

This scholarship is awarded to a student majoring in music. Applicants must be residents of the greater Lowell area for a period of not less than 5 years, have financial need and must have achieved good scholarship.

Jacob Ziskind Memorial Fund for Freshmen:

Scholarship funds are restricted to freshmen. Recipients must exhibit good character, scholastic aptitude, initiative and ability.

SCHOLARSHIPS AND AWARDS PRIMARILY FOR UPPERCLASSMEN

AID Awards and Trust Fund:

Awarded to non-traditional minority students in good academic standing, financial need, and either demonstrated leadership ability through community involvement and/or involvement in extra curricular activity, or have demonstrated very significant academic improvement.

Allied Chemical Corporation Scholarship:

The Allied Chemical Corporation has made available on a one-year basis a scholarship for an upperclassman majoring in plastics.

Michael K. Anderson Memorial:

Established by Irving Anderson in memory of his son Michael, this award is made to a student in the College of Music who is under the age of 25.

Asphalt Paving Scholarship Award Fund:

Awarded to an outstanding senior in Civil Engineering. See department chairman.

Boston Paper Trade Association Award:

One \$300 award is available to an upperclassman enrolled in the chemical engineering paper option program. Award is based on character, proven interest in the paper industry, and academic performance.

Custom Materials, Division of 3M Corporation, Scholarship:

Custom Materials of Chelmsford has made available on a one-year basis a scholarship for an upperclassman majoring in plastics technology.

American Hoechst Corporation, Plastics Division Scholarships

This company, of Leominster, makes available two one-year scholarships to deserving students in plastic technology. Recipients must be residents of Massachusetts, with preference given to students living in the Leominster area. Other students may qualify if applicants from Leominster or Massachusetts are ineligible. Qualifications require contributions to extra-curricular activities and suitable personality characteristics.

Gehring Foundation Memorial Scholarships:

Scholarships in the memory of Henry C. Gehring and his son, Edward, are made available to upperclassmen.

Russell Weeks Hook Scholarships:

Six undergraduate scholarships, two in each of the three upperclasses are awarded to needy students who are majoring in chemistry. See department chairman.

Mass. Assoc. of Land Surveyors and Civil Engineers:

(MALSCE) Scholarships awarded in memory of Charles Anderson and Llewellyn Schofield. Must be Civil Engineering major, a resident of Massachusetts, and have completed freshman year. See Chairman of department.

Mobay Scholarship:

The Mobay Chemical Corporation of Pittsburg sponsors a scholarship on a one-year basis which is awarded to a deserving upperclassman in plastics engineering.

National Association of Plastics Distributors:

\$1000. scholarship awarded to a student majoring in Plastics. See department chairman.

NYPRO (Division of E.I. duPont de Nemours):

Plastics Engineering. Awarded to a sophomore, renewable for junior and senior years. Preference given to employees or children of employees or residents of Worcester County area. Must have a CUM of 2.7 or better.

Paper Engineering Scholarship:

12 or more scholarships with annual stipends of \$500 are available to upperclassmen and selected graduated students who are enrolled in the engineering-paper option program. Applicants must have achieved minimum GPA of 2.0. Contributors to the scholarship fund include many national known paper companies.

Plastics Engineering:

Each year companies in the plastics industry make funds available for scholarships to students in plastic engineering. Applications may be obtained from the chairman of the scholarship committee in the Plastics Engineering department. See department chairman of details.

Harry Reimer Award:

A medallion and a U.S. Bond are given annually to an individual who is selected on the basis of scholarship, extra curricular activities, and over all contributions to the University over the 4 year undergraduate period.

Society of Plastics Engineers Scholarships:

2 scholarships are granted annually by the Eastern New England Section of the Society of Plastics Engineers, Inc. to upperclassmen majoring in plastics engineering. One scholarship is awarded by the Southeastern New England Section of the Society of Plastics Engineering to an upperclassman majoring in plastic engineering.

Carl Tapper Award:

This award is made to a senior in the College of Music who has established the best record in the two required semesters of apprentice teaching and who shows the most promise for success in a career of music education.

Textile Veterans Association Award:

A medallion and a U.S. Bond are given to an individual who is selected on the basis of scholarship, extracurricular activities and over-all contributions to the University over the four year undergraduate period.

Jacob Ziskind Memorial Scholarship Fund:

This fund, established by the Trustees of the Jacob Ziskind Trust for Charitable Purposes, provides scholarships to sophomores, juniors and seniors who have demonstrated high scholastic accomplishment, exhibit qualities of good character and leadership, and who are in need of financial assistance. Preference is given to those students who have received grants from the Jacob Ziskind Memorial Fund for Freshman.

Mark Jonathan Elliot Scholarship Award:

The purpose of the award is to encourage recipients to further their education on the graduate level in textile or textile related fields of study.

VETERANS BENEFITS

The Veterans Administration has approved the University of Lowell for undergraduate study. Veterans must present a certificate of eligibility available from the Veterans Administration, Kennedy Building, Government Center, Boston, Massachusetts. Upon receipt of this certificate, the University will notify the Veterans Administration to initiate monthly payments to the student. Veterans who are registered in 12 or more semester credits are paid for full-time training; for 9-11 semester credits, three-quarter time training; and for 6-8 semester credits, half-time training.

A citizen of Massachusetts who is defined as a "Vietnam Veteran" and whose service is creditable to the Commonwealth may be issued a certificate of tuition exemption if he is enrolled in the University as a full-time student. Certificates must be renewed annually prior to the beginning of each academic year, are in effect only during such time as the student remains in good standing at the University, are limited to a period of study which may not exceed four years, and are issued during an eight-year period from the date of discharge or release from active service. In order to receive a certificate of tuition exemption, an eligible veteran must present his discharge papers at the Office of the Adjutant General, State House, Boston, Massachusetts, and must provide the Office of the Registrar, University of Lowell, with a certificate of eligibility.

A veteran who is entering the University for the first time is required to pay the application and acceptance fees within the period designated on the application form for admission. The acceptance fee of \$50.00 is refundable, upon request, after the certificate of tuition exemption has been issued by the Office of the Registrar. The application fee of \$10.00 is not refundable. Tuition exemptions do not cover fees of the University.

Inquiries directed to the University concerning veterans affairs should be addressed to Office of the Registrar, University of Lowell, Lowell, Massachusetts 01854, or to the Veteran's Affairs Office, Pasteur Hall 203.

HOUSING

There are six residence halls for undergraduates at the University housing some 1650 students. The University is oriented to a program which recognizes the educational advantages of both classroom instruction and extra-curricular activities. It is the objective of the Residence Hall Program not only to provide the best possible housing arrangements but also to provide the opportunity for individual students to develop academic excellence, a sense of responsibility for their own actions and the leadership and social skills expected of college graduates. The University attempts to develop these opportunities to the fullest extent and to make residence hall life an important asset of its education mission.

General Housing Policy

Rooms in the residence halls are contracted for the full academic year, exclusive of periods when the University is in recess. Students are not permitted to remain in residence halls during periods when the University is not in session. The University is not responsible for providing housing accommodations during vacation periods. Those students who cannot return to their homes during these periods must make their own off-campus housing arrangements. The Office of the Dean of Students maintains a list of off-campus housing.

Housing Costs

The room rental charge is presently set at \$1,058.00 per academic year and is payable in two equal installments on the dates specified as the due date for all bills at the beginning of each semester. Each student must submit a \$100.000 room reservation deposit at the time the residence hall contract is returned to the Business Office. This deposit reserves the room until occupancy and is applied to the second semester room rental. Any student who cancels his or her residence hall contract prior to the beginning of the first semester or who withdraws from the dorm within the first five weeks of the semester will forfeit this deposit.

Housing Eligibility

To be eligible for occupancy in the University's undergraduate residence halls, a student must have registered at the University as a full-time undergraduate student. Full-time registration is defined as an initial semester course load of 12 or more credits. Students with less than 12 credits, Graduate students, Evening school students and students in special programs are eligible for housing pending availability of space. Individual housing eligibility is not transferable. A student who withdraws from all courses or who withdraws from the University must terminate occupancy of University residence halls.

Housing Assignments

Upperclassmen and women are given the opportunity of signing for the dorm, room and roommate(s) of their choice in the Spring of each year. Incoming freshmen are assigned dormitory space randomly unless a special request is made to the Housing Office. In that case every effort is made to honor that request. Changes of room assignment are permitted upon application to the staff of the dorm and with their knowledge and approval.

Housing Priority

Because of the great demand for on-campus accommodations, the following Housing Policy is currently in effect:

A. Massachusetts residents will be given preference in dormitory placement.

B. In the assignment of dormitory space to *new students*, highest priority will be given to those Massachusetts residents living more than 20 miles from the University of Lowell.

1. The students who qualify under this regulation must have filed application and have been accepted for admission by April 15th.

2. Their tuition prepayment must have been received not later than May 1st.

3. Rooms will be assigned to these students in the order of the date that the prepayment of tuition (\$60.00 Freshman - \$50.00 transfers and reinstates) is received in the Business Office.

C. *If there is space available* after the above mentioned students have been assigned rooms, those students accepted before April 15 who were excluded from the dormitories because of proximity to the University will be given space in the order of the date of their tuition deposit payment.

D. Exceptions to this policy will be made for handicapped students and when extenuating circumstances require. Such circumstances will be determined by the Counseling Center and/or the Office of the Dean of Students. Since this policy may cause hardship for some students, the Office of the Dean of Students will, therefore, continue to provide assistance in the area of off-campus accommodations.

Residence hall rooms are furnished with beds, mattresses, desks, desk chairs and closets. Each student is expected to provide pillow, linens and blankets.

All residents are given a copy of the Residence Hall Rules and Regulations with their dorm contract and are subject to these established prohibitions and observances. Any alterations to dorm rooms must be approved by the dormitory staff. Students are encouraged to make their rooms comfortable and liveable but within the guidelines offered in the Rules /Regulations.

The University does not carry insurance which will compensate students or their families for losses suffered on campus due to such hazards as fire, theft or water damage. For most families such insurance is highly desirable, either as an extension of present home insurance or as a special contract.

Residence Hall Staff

Each residence hall is staffed and managed by upperclassmen and women or graduate students who have been selected through a very thorough evaluation process. Under the guidance of the Resident Advisor, floor counselors lend assistance and support to the dorm residents. The Resident Advisors are responsible to the Assistant Dean of Students who supervises and coordinates the administrative responsibilities associated with the operational aspects of residence hall living. The dorm staff is especially valuable to freshmen in providing information concerning academic and social organizations and cultural and educational activities and by assisting in the development of those extra-curricular pursuits which can be a meaningful part of one's total education.

Interdormitory Council

Students are encouraged to become involved in the things which affect their daily lives in the dormitories. Each dorm elects from among its residents floor representatives and officers to comprise a Dorm Council. This body oversees cultural, social and athletic programs in the dorms. Each dorm sends representatives to the overall governing body called the Interdormitory Council or the IDC. This group has several committees which deal with maintenance issues, social functions, athletic programs, food issues and many other items which affect a resident student's life. Residents are encouraged to participate in the activities planned by their dorm council and by the IDC and to get involved actively in these groups. During the year many activities are offered in the dorms; touch football, softball, street hockey, volleyball; transportation is provided to many varsity sporting events; mixers and semi-formals, cook-outs, roller-skating parties, trips to Boston and New York at Christmastime and other such events are organized by the IDC.

Room Rent and Reservation Deposit

The room rental charge is \$1000 per academic year and is payable in two equal installments. Payment for the first semester is due on or before August 15 or, in the case of late acceptance, within fourteen days of billing. Second semester rent is due and payable as noted on the spring semester invoice. Each student must submit a \$100 room guarantee deposit at the time the residence hall reservation and contract is submitted to the Business Office. The deposit reserves the room until occupancy and is applied to the second semester room rental. Any student who cancels his or her residence hall contract prior to the beginning of the first semester or who withdraws within the

first five weeks will forfeit the \$50 room guarantee deposit. Any student who withdraws subsequent to the first five weeks but prior to the beginning of the second semester will forfeit \$25 of the room guarantee deposit. (cf. also "Refund Policy", p. 25, for dormitory refund schedule.)

Residence Hall Contracts

Individual residence halls may develop and adopt rules and regulations of student behavior which are not contrary to established policy of the Board of Trustees. All residents, in any event, are subject to established prohibitions and observances which are specified by official contracts and are required to comply with University policies concerning billing, health records, automobiles, parking, and food services.

Damage Deposit Requirement

Residence halls are constructed, equipped, and maintained through funding provided by bonds issued by the University of Lowell Building Authority. Room rents and damage assessments are established to provide a fund sufficient to pay building and operating costs. This funding policy requires that a student who has registered for and occupied a room in a residence hall be held financially responsible for room rent and for damages to both his or her occupied room and common areas. Students are individually responsible for damage to the furniture and quarters which they occupy. In the event of damage to common areas (corridors, lobbies, shower rooms, etc.), the cost of repairing such damage will be apportioned among all residents of the concerned residence hall. All resident students must have on deposit a total of \$25 with the Business Office at the beginning of each academic year. This sum will be held in escrow pending assessment of residence hall damages and will be refunded upon termination of residence hall occupancy when such damages have not been assessed. Any interest accrued from the damage deposit shall be held in a trust fund by the Office of Student Services to be used for the general improvement of residence hall life. In the event that assessed damages are in excess of the deposit, an appropriated bill will be rendered.

DORMITORY FACILITIES AND FOOD SERVICES

There are six dormitories for undergraduates at the University, housing approximately 1,650 students. A brief description of these residence halls follows:

Bourgeois and Leitch Halls

Bourgeois and Leitch Halls are located on Pawtucket Street (North Campus) on the banks of the Merrimack River and can accommodate approximately 330 students each (currently all male) in predominantly double rooms. This dorm complex also provides some triple rooms, limited lounge/recreation areas and laundry facilities. The area directly behind these dorms is a lighted athletic area with courts for basketball, volleyball, tennis and street hockey.

Fox Hall

Fox hall generally referred to as "the Towers," is directly across the street from Leitch and Bourgeois. It houses a residence hall on floors 7-18 and a student union complex on the first six floors which contains the student activities area on the North Campus. Included in this area are a Rathskellar, game room, several meeting and conference rooms and lounge areas. There is a 700 seat dining hall which is used by the residents of Fox, Leitch and Bourgeois. In addition, many of the more than 100 clubs and organizations have office space here. The offices of the Student Government, the student year book and newspaper are also housed in this building. The upper twelve floors house a co-ed dorm facility (single sex by floors) for approximately 500 students. There are kitchenettes, T.V. lounges and laundry rooms on alternating floors. Residents of Fox Hall who wish to have private phones installed in their rooms may do so by making appropriate arrangements with the Lowell Business Office of the New England Telephone Company.

Smith Hall

Smith Hall, located at 20 University Avenue (North Campus) houses approximately 120 men. Located adjacent to the Lydon Library, this dormitory is very popular with upperclassmen because of its closeness to academic buildings, and its size. A dining hall for Smith and Eames is located on the ground level of Smith.

Eames Hall

Eames Hall, located at 20 University Avenue (North Campus), houses some 120 women. The first floor of this dorm has been extensively renovated to serve the needs of handicapped men and women students. This building also contains laundry and recreation rooms and a television lounge.

Concordia Hall

Concordia Hall is the only dorm located on the South Campus. It is a six-story building overlooking the Merrimack River and currently houses 186 women. This dorm contains lounges, a T.V. room, a recreation area, laundry facilities, a kitchenette and music practice cubicles with piano.

Food Services and Dining Halls

Dining hall facilities are located in the Cafeteria Building (South Campus) and in the Fox Student Union and Smith Hall (North Campus). Dormitory residents are required to subscribe to one of the food plans offered. A check, money order, or draft for the full amount of the selected meal plan, payable to the University of Lowell, must be forwarded to the Office of the Bursar when payment is made for University tuition and fees.

Information on available meal plans, dining hall regulations, etc., is available from the office of the Dean of Students. (Cf. "Refund Policy", page 25, for food plan refund schedule.)

LIBRARY SERVICES

The University libraries, which consist of the Alumni-Lydon Library (North Campus) and the O'Leary Library (South Campus), have a seating capacity of 2,000. Present library holdings include over 300,000 books and periodicals and a large number of such non-print materials as audio recordings, video tapes, films and microforms. The O'Leary Library provides resources in the social sciences, humanities, and health areas and houses the ERIC microfiche collection (Educational Resources Information Center). The Music Listening Room of O'Leary Library includes 118 listening stations and over 7,000 scores. The Alumni-Lydon Library is rich in resources for science and business management fields. Special collections of the University Libraries include the collections of - the American Association of University Women (Greater Lowell Chapter), Boston and Maine Railroad Historical Society, Lowell Historical Society, Lowell Museum, Manning Family, Middlesex Canal Association, Proprietors of the Locks and Canals on Merrimack River, University Archives and a collection of regional histories. Other valuable resources include New England maps published by the Geological Survey of the U.S. Department of the Interior, and educational media. The University libraries provide interlibrary loan services and also function as a U.S. Government depository.

Reference Services

The University of Lowell Libraries provide professional reference services to the students, staff, faculty and alumni of the University in the following areas: bibliographic instruction; interlibrary loan; computerized literature searches; manual literature searches; and specialized classes in search techniques. In addition, specialized services in government documents are provided by the Reference Department.

The Library has been in the process of automating since 1978. To date, all cataloging of new material is accomplished using the bibliographic database and terminals of the national network, OCLC. With the purchase of the ALIS II computer system from Dataphase of Kansas City, Missouri in 1979, the library has proceeded to

build one of the few public on-line catalogs in the nation. The circulation subsystem was implemented in the summer of 1982 and the acquisition subsystem is scheduled for the latter quarter of 1983.

Media Services

Media Services, the audio-visual unit of the University Libraries, operates facilities in both library buildings. Media Services functions in three areas: 1) media presentation, 2) media production and 3) music listening. The music listening room supports academic programs and is also available for recreational listening. Media production is an academic support unit providing audio, video and slide programs. Media presentation involves screening facilities in each library, equipment for loan and University film and video collection.

Library Regulations

New students should have their pictures taken for an identification card at the beginning of the academic year. This photo-identification card must be presented upon request for admission to the library facilities and whenever a student wishes to take materials from a library. The identification card is valid until graduation, termination of enrollment, or revocation, and is not transferable. The owner of the identification card is responsible for all material charged to his or her card until such time as library authorities have been informed that the card has been lost or stolen.

Students are not permitted to bring food or beverages into library areas and are prohibited from socializing, conversing, or generally engaging in activities in a library setting. A student's library privileges, including the right to study in library areas, may be revoked when library rules concerning appropriate conduct have been violated.

Circulation and Fine Policy

The fine for regularly circulating books at the University of Lowell Libraries is .10¢ a day, with a maximum limit of a \$10.00 fine on each book. If a book is lost, the patron must pay the current replacement cost plus a \$3.00 processing fee. The fine for overdue reserve books is \$1.00 a day.

No books may be renewed over the phone or by writing down the call numbers to renew a book. *All patrons must bring the book in to renew it.*

Borrowing Privileges for Each Patron Category

	Charge Limit (Books)	Charge Length (Days)	Renewals	Renewal Length (Days)
1. Alumni	10	14	2	7
2. Evening Graduate	10	14	2	7
3. Evening Undergraduate	10	14	2	7
4. Day Undergraduate	15	14	2	7
5. Day Graduate	25	14	2	7
6. Graduate Assistants	30	30	2	30

The Library will proceed to file academic dismissal procedures and hold diplomas and transcripts on any student who refuses to pay the fines or books

The Library will suspend borrowing privileges for those students who owe \$1.00 or more in fines, and any student or faculty member who exceeds his/her charge limit.

All patrons must register with the Library every *semester*. Additional information concerning the University Library System and interlibrary loan services is available at the reference desk.

STUDENT ACTIVITIES AND REGULATIONS

At Lowell, the student can find an organization which suits his or her particular interest whether it be committee organizations, sports, government, religion, the arts, community service, honorary societies, politics, the

military, or media. Major all-campus events are University Week and Spring Carnival. In addition, residence halls and student groups sponsor other all-campus events throughout the year. The variety of events on campus includes student art shows, concerts, movies, intramural sports, and scholarship awards ceremonies.

The Undergraduate Student Government, the Graduate Student Government, the Interfraternity-Sorority Council, and the Interdormitory Council provide unlimited opportunities in student government at the all-campus level. Leadership opportunities are provided in residence halls, student organizations, and Greek letter groups. Students also participate in the disciplinary system and in most University committees.

STUDENT GOVERNMENT

The Student Government of the University of Lowell is an elected undergraduate body whose purpose is to provide a formal means for promoting responsible and effective student affairs, for maintaining academic freedom, academic responsibility, and student rights, and for enhancing educational, social, and cultural opportunities on the University campuses. The Student Government consists of three branches: the Student Senate, the Activities Commission, and the Student Court.

THE STUDENT UNION

The focal points of student activities are the newly constructed student union buildings on the North and South campuses. The Fox Hall Student Union on the North Campus contains a student activities area of six floors. Located in this area are a rathskeller, a game room, conference and meeting rooms, a theatre, and lounge areas. This facility also contains a dining hall with a seating capacity of 700 which can be converted to an open area for recreational use. Offices for student organizations, which are located in the North Campus Student Union, include the student newspaper, the yearbook, sororities, fraternities, and special interest clubs. The Student Union on the South Campus contains a student lounge and recreation area, offices and meeting rooms for student and alumni organizations, the PUB, and the Office of the Student Senate.

STUDENT ATHLETICS

Athletic Facilities

The center for University athletics is the Costello Gymnasium located on the North Campus. It houses the offices of the Director of Athletics, the coaching staffs and faculty of the physical education department. The gymnasium, which seats two thousand spectators, also includes a collegiate swimming pool, weight-training facilities, areas for gymnastics, wrestling and judo, training rooms, two handball and three squash courts, a rifle range, team dressing rooms and locker rooms. Adjacent to the gymnasium are the main University athletic fields including four tennis courts. Mahoney Hall, on the South Campus, includes a gymnasium, weight-training facilities, locker rooms and training room. An athletic field and three tennis courts are located nearby.

Intercollegiate Memberships

The University of Lowell is a member of the following athletic groups: The National Collegiate Athletic Association (NCAA), Eastern College Athletic Association (ECAA), New England College Athletic Association (NECAA), and Collegiate Sports Information Directors of America (COSIDA). Additionally, the University holds memberships in many of the major associations concerned with the support and regulation of particular sports activities.

Varsity Sports

Opportunities to participate in an extensive and varied program of varsity sports are available to men and women students of the University. Approximately twenty-five activities, covering all seasons of the year, are offered by the University. Intercollegiate teams participate throughout the New England area and the Eastern seaboard. Teams or individuals who qualify regularly can compete in national tournaments.

Club Activities

The University also offers its students a wide choice of sport activities below the level of varsity completion.

Intramural Activities

The office of the Intramural Director offers an extensive and varied intramural program at the University. Four leagues (Fraternity, Sorority, Independent, and Women) compete in such activities as touch football, volleyball, softball, swimming and diving, track and field, basketball, wrestling, rifle shoot, turkey trot, hockey, football and softball field days, as well as a wide range of individual activities: handball, squash, chess, badminton, paddleball, bike race, tennis, and cross country. Interested students, faculty, and staff are encouraged to participate in any intramural activity.

Recreation

Students are urged to supplement their intercollegiate, intramural, and required activities with a regular program of recreation. Athletic facilities are available on a recreational basis throughout the year. Equipment needed for most recreational facilities may be obtained from the Issue Room upon presentation of the student's ID card.

STUDENT ORGANIZATIONS

Honorary and Professional Societies

Alpha Nu Sigma (Nuclear Science and Engineering)
American Chemical Society
American Society for Chemical Engineers
American Society for Civil Engineers
American Society for Mechanical Engineers
American Meteorological Society
American Nuclear Society
Association of Pulp and Paper Industry
Eta Kappa Nu (Electrical Engineering)
Institute of Electrical and Electronics Engineers
Music Educators National Conference
Pi Lambda (Education)
Pi Mu Epsilon (Mathematics)
Pi Tau Sigma (Mechanical Engineering)
Radiological Health Physics Society
Sigma Xi
Society for Physics Students
Society for Plastics Engineers
Society for the Advancement of Management
Society for Industrial Technology
Tau Beta Pi (Engineering Honor Society)

Special Interest Organizations and Clubs

A large number of special interest groups and clubs, as well as social fraternities and sororities exist at the University. For a list of such organizations, their statements of purpose, etc., students are directed to the Office of the Dean of Students or to the offices of the Student Government.

STUDENT REGULATIONS

Students of the University are subject to both academic regulations and rules of general conduct. Academic regulations are cited elsewhere in this publication under the heading "University Academic Policies" and in

chapters devoted to college programs. The regulations cited below are concerned with the maintenance of basic standards of good order and conduct on campus and are formulated for the general welfare of the University community.

Automobile Regulations

All students owning or driving automobiles are required to register their vehicles with the University at the time of registration, or at the time thereafter when vehicles are first driven to the University, and to place parking stickers on the rear windows of their automobiles. Students who do not display parking stickers and who park on University property are subject to fines. Student parking is restricted to designated lots. Parking on city streets is permitted in accordance with posted regulations. Students are not permitted to park in University driveways or in faculty parking areas.

Identification Cards

Each student of the University is required to possess an official identification card and to present this card when attending University functions or when requested to do so by administrators, faculty, and campus police. Students are required to surrender their identification cards at the time they withdraw from the University or upon notification of dismissal. Freshmen and transfer students who enter the University at the beginning of the fall semester may secure their identification cards during the period established for freshman orientation. Students entering the university at the beginning of the spring semester will be notified concerning the schedule for issuing identification cards. A student who has lost his or her identification card should report this fact to the Office of the Dean of Students, Cumnock Hall, North Campus, as soon as possible and should make arrangements at this time for securing a replacement. A fee of \$2.00 is charged for issuing a second identification card.

Required Notification Of Changes Of Student Status And Address

All changes in student records (including changes of academic programs, course registrations, official name, address, and telephone number) *must be made through the Office of Registrar, Southwick Hall*. Notification of other offices of the University does not constitute official notification unless also made with the Registrar.

Student Behavior

Although the administration and faculty of the University subscribe to the view that students have the right of self-determination over their private lives and public conduct off-campus and accordingly refrain from regulating the extra-campus behavior of students, they expect that every student upon enrolling in the University will comply with University rules and regulations. The expectation is that each student will disavow offenses against the academic code of behavior; will not engage in physical or verbal abuse of fellow students or of faculty or staff; and will refrain from misusing equipment, damaging University property, and interfering with the right of administrative offices and staff, faculty members and other students to use University facilities.

In the case of student misconduct which constitutes a violation of State or Federal criminal law, complaint shall be made to the appropriate prosecutor and no administrative punishment will be substituted for appropriate criminal prosecution. The cost to replace or repair University property which has been stolen, damaged or destroyed will be charged to the offending students. Students who violate parking regulations are subject to towing and fines.

Procedures cited below are for student offenses of a non-academic nature. Other sections of this bulletin should be consulted for policies governing dismissal and penalties for academic dishonesty.

Student Disciplinary Procedures (Non-Academic)

The underlying purpose of student disciplinary procedures is educational. Such procedures accordingly seek to promote the achievement of self-discipline and self-direction on the part of the student by fostering personal responsibility and accountability. In the administration of these procedures, the University recognizes the

legitimate concern of the student body, the faculty, and the administration is committed to a proper balance between protection for the individual and the academic community. In the imposition of disciplinary penalties, the University makes every effort to avoid dual punishment of an offender for the same wrongful act and therefore refrains from disciplinary action when sufficient disposition of an offense has been made, or appears likely to be made, by a court of law. Unlawful acts and acts of misconduct which are committed off-campus* are not the responsibility of the University and are not subject to adjudication by student disciplinary procedures.

*Fraternities and sororities may request the assistance of the Dean of Students in matters which they cannot handle themselves.

The Role of the Dean of Students

Except for charges of academic dishonesty, all complaints concerning student misconduct or charges concerning violation of administrative requirements of the University must be forwarded in writing to the Dean of Students, who, within a reasonable time thereafter, shall provide the student with the name of the complainant, a copy of the charges filed, and a statement of hearing procedures and individual rights of due process. Within five academic days of this notification, the Dean of Students shall schedule a personal interview with the student, at which time the student may explain the circumstances of the complaint or charge and/or may affirm or deny the charges or complaint as filed, may call witnesses on his or her behalf, and may confront and question those who appear to give testimony. Within a week of this interview, the Dean of Students shall render a decision concerning the complaint or charge filed and shall forward a copy of his decision to the student by registered letter, return receipt requested. In the event that the Dean has specified a sanction, his letter shall notify the student of his or her right to appeal the decision to a Board of Appeals and to be represented and/or assisted by a faculty advisor in making such an appeal.

The Dean of Students shall have authority to impose a sanction without recourse by the student to subsequent hearings if the student has failed to report for a personal interview as scheduled and has not been excused from reporting for good and sufficient reason. If a student against whom a sanction has been imposed makes no appeal to a Board of Appeals, the punishment determined by the Dean of Students shall be implemented within ten days. Pending action on an appeal of sanction imposed by the Dean of Students, the status of a student shall not be altered and his or her right to be present on campus and to attend classes shall not be suspended unless, in the opinion of the Dean of Students and the Vice President of Student Affairs, failure to implement such sanction may reasonably pose a threat to the safety of persons or the protection of University property.

The Composition and Role of the Board of Appeals

The Board of Appeals shall consist of two faculty members appointed by the Chairperson of the Faculty, two administration members appointed by the Vice-President for Student Affairs, and three student members appointed by majority vote of the Student Senate. An alternate shall be appointed respectively by the Chairperson of the Faculty, the Vice-President for Student Affairs, and the Student Senate for each regular member designated. Upon written notification to the Board at least two days prior to a scheduled hearing, the student defendant or the Dean of Students has the right to remove, without cause, one regular member of the Board and to replace such member with his or her designated alternate. The Board shall elect a person from among its members who shall conduct the hearing and who shall assume responsibility for assuring an accurate record of the hearing.

An official record of the hearing, including a record of testimony, shall be made by a duly appointed stenographer or by tape recorder. The transcript or tape recording shall be for the use of the Board only, and upon the conclusion of the hearing it shall be deposited with the Vice-President of Student Affairs, who shall subsequently release this record only upon the direction of the President or upon the order of a court of competent jurisdiction. Upon the student's graduation or withdrawal from the University, a copy of the official record of the student's hearing may be released to the student when such release has been approved by the University President. The original transcript will be kept in the Office of the Vice-President for Student Affairs.

The Board of Appeals shall receive a written charge from the Dean of Students which provides the name of the accused student and the specific allegation of student misconduct. A copy of such charge shall be conveyed to the student by the Board, together with a notice of time and place of official hearing before the Board. The student may be assisted in his or her defense by an advisor of his or her choice, may present evidence, and may call witnesses in his or her defense. Hearings before the Board of Appeals shall be private unless the student has filed a written request for a public hearing with the Board at least two days prior to the scheduled hearing date.

Attendance at Hearings of the Board of Appeals

The following individuals shall have a right to be in attendance at a hearing of the Board of Appeals: the Dean of Students, the student defendant, the student's advisor, and the legal counsel of the Board of Trustees. Individuals other than those enumerated above who have a direct interest in the proceedings may be permitted to attend hearings at the discretion of the Board. The Board may revoke such permission at any time during the course of a hearing. A decision to permit an individual's attendance or to revoke such permission shall require a 5/7 affirmative vote of the Board.

Admissibility of Evidence

Decisions of the Board of Appeals shall be based solely upon evidence which has been introduced during official Board hearings. Improperly acquired evidence shall not be admitted before the Board. In any proceeding, the admissibility of evidence shall be governed by the Rules of Evidence which are specified by Chapter 300 A of the General Laws (State Administrative Procedure Act) concerning adjudication. Information pertaining to the defendant's academic standing or to his or her previous record of offenses shall be introduced in a hearing only if the Board deems such information to be relevant. Each witness testifying during a Board hearing shall be called into the hearing room at the time he or she is to testify and shall leave the hearing room immediately after providing testimony. Members of the Board, the student defendant, the defendant's advisor, and the Dean of Students may question any witness concerning his or her testimony.

Powers of the Board of Appeals

The legal counsel for the Board of Trustees shall be the legal advisor to the Board of Appeals. All questions as to the scope of the hearing, legal procedures, legal substance or legal relevancy shall be determined by Board counsel. Following a review of evidence at the conclusion of a hearing, the Board of Appeals by an affirmative vote of 5/7, the Board of Appeals may over-ride a decision of legal counsel. Following a

review of evidence at the conclusion of a hearing, the Board of Appeals by an affirmative vote of 5/7 may affirm, reverse, increase, or decrease a sanction which has been imposed by the Dean of Students. Upon the conclusion of each hearing, the Board shall forward a written statement of its decision, signed by all Board members, to the President of the University, the student defendant, and the Dean of Students. All decisions of the Board of Appeals shall be implemented on the third academic day (including summer sessions) following the date of Board notification to the student defendant unless the Dean of Students or the student defendant notifies the Board in writing of his or her decision to appeal the Board's decision to the President of the University.

Appeal to the President of the University

An appeal to the President may be initiated by the Dean of Students or the student defendant and must be made in writing to the Vice-President for Student Affairs within two academic days following notification by the Board of Appeals. The President's review shall be based on the complaint, the decision of the Dean of Students, the record of the hearing, and the decision of the Board of Appeals. The decision of the President shall be implemented within ten days following the date of presidential notification to the student defendant unless the student defendant notifies the President in writing of his or her decision to appeal the President's decision to the Student Affairs Committee of the Board of Trustees. In the event that the President alters the decision rendered by the Board of Appeals, he shall provide a written statement of his decision, together with his reasons, to the Board of Appeals.

Appeal to the Board of Trustees

A student defendant has the right to appeal the decision of the President to the Student Affairs Committee of the Board of Trustees. This appeal must be made in writing to the Vice-President for Student Affairs within two academic days following the date of presidential notification to the student defendant. All decisions of the Student Affairs Committee of the Board of Trustees are final and shall be implemented within ten days.

STUDENT SERVICES

Student Personnel Services comprise a number of offices with primary concern for the general welfare of all University students, as well as services and programs which are conducted by the faculty and administrative staff for the enrichment and well-being of student constituencies and for the protection of individual rights.

Special Academic Services (SAS)

The Office of Special Academic Services is dedicated to the recruitment and retention of non-traditional students and provides special programs in skill development and supportive services. Through the office of Alternatives for Individual Development (AID) two related programs of assistance are administered. The regular program, for matriculating students and applicants who are admitted to the University as matriculating students, provides on-going counseling, tutoring, cultural enrichment, classes in reading and writing techniques, and limited financial aid. Individuals who qualify for this program and who are newly admitted to the University are also given the opportunity to participate in a precollege refresher program which is offered during the summer. A companion program, the Educational Opportunities Program, provides qualifying individuals from disadvantaged environments with an alternative means for securing matriculation status through an earned admissions process and is described elsewhere in this publication under the heading "Admission Policies: Educational Opportunities Program." Individuals who are granted provisional, non-matriculated status in this program must achieve regular matriculation status no later than their fourth semester of enrollment.

The Special Services Student Learning Center provided skills development courses and tutorial assistance to EOP and A.I.D. students as well as other students enrolled in the University who qualify for services through this program. The Student Learning Center offers the following courses: Foundations of English, Foundations of English as a Second Language, Foundations of Reading, Foundations of Mathematics, and Foundations of Civics. In addition the Center offers skills development workshops as well as tutorial assistance in varied subject areas.

The Talent Search Project Administered by SAS, offers educational, career, and vocational counseling and information to individuals to encourage them to secure training after high school in a college, university or vocational training center. The Project has staff of counselors who assist individuals in selecting educational and career opportunities as well as in locating the financial assistance to make these opportunities a reality.

Campus Security

The Campus Security Force is responsible for the security of University property, students, and employees and for parking control. Guards are assigned to parking control duties during the day and patrol of residence hall

areas at night. *Student ID cards or other means of identification must be shown upon request to any properly identified member of the security force.* The policies of the Campus Security Force are governed by applicable federal, state, and local laws and by regulations of the Board of Trustees. In addition, members of the Campus Security Force are guided by a code of ethics adopted by the International Association of College and University Security Directors.

Student Advising

Student problems of a non-medical, non-academic, or non-psychological nature are handled by the Office of the Dean of Students. Academic problems are handled by faculty advisors. The University recognizes that collegiate work is often done under conditions of stress, and faculty members are available for student conferences should a student so request.

Special counselling and academic advising are provided as follows:

Academic Advising	Faculty Advisors, Department Offices;
Career Counselling	Counselling Staff, Student Union, South Campus.
Foreign & Minority Student Advising	Mrs. G. Coughlin, Office of the Dean of Students, Cumnock Hall
Personal Counselling and Development	Counselling Staff, Student Union, South
Pre-Medical and Pre-Dental Advising	Dr. David Eberiel, Department of Biological Sciences
Veteran's Affairs Office	Pasteur Hall 203

Counselling Center

The Counselling Center is located on the third floor of the South Campus Student Union Building.

The University has established this center to provide services to all students in the areas of personal adjustment and development, career development, educational planning and mental health. All services are free of charge.

Individual and group counselling are offered for personal difficulties and interpersonal problems which interfere with academic and personal growth. Support groups for older students returning to school, and workshops to develop better communication skills and appropriate assertive skills are conducted regularly.

In the area of *academic support*, the Center offers workshops for the development of better study skills and for managing test-taking and performance anxiety. Students may call on Center personnel to help resolve problems with members of the faculty or of the University administration.

Specialized *career development* services are provided both through individual counselling and workshops. These are designed to assist students in choosing a major field of study and in making career development decisions consistent with their skills, interests and values. As requested, programs are conducted in conjunction with academic departments and student organizations. A *Career Development Resource Library* is open on a walk-in basis during normal office hour. Counsellors are available to assist students in using these resources.

The Counselling Center is open from 9:00 to 5:00 each day, and at other times by arrangement. Students are encouraged to drop by any time or to call for an appointment on Extention 2390.

Disabled and Handicapped Students

The University is becoming increasingly more accessible to academically qualified students who are physically disabled. Although some architectural barriers still remain, disabled persons can traverse the campus with minimum difficulty. University Libraries, the Student Unions, Eames Hall, and more recently constructed classroom buildings are accessible to students in wheel chairs. Early registration, preferential scheduling, housing assistance, a reader's directory for the blind, alternative testing procedures (e.g., verbal rather than written examinations for the blind or manually impaired), and special parking arrangements are some of the special services available to disabled students. Since admission to the University is based entirely on the academic qualifications of the applicant, admission procedures remain the same for all applicants, regardless of disability. For further information, contact the Dean of Students Office, Cumnock Hall (North Campus).

Equal Opportunity and Title IX

Federal and State laws require that no student be discriminated against or harassed on the basis of age, national origin, race, religion, sex or handicapped, marital, or veteran's status. The Affirmative Action Office, which has the overall responsibility for the implementation of Equal Opportunity/Affirmative Action, is located on the first floor of Dugan Hall (South Campus). This office deals not only with discrimination and harassment complaints but also with the monitoring of actual practice and written policies and procedures, e.g. student activities, course offerings, teacher and student attitudes. Any student who believes that he or she has been discriminated against or harassed or who believes that the University in any of its aspects is operating in a manner which adversely affects female, handicapped, and minorities students, or veterans should contact the Affirmative Action Office immediately.

Health Services

The University maintains a Student Health Service Office on the North Campus at 30 Standish Street, open 8:00 a.m. to 4:30 p.m., Monday through Friday. This office is staffed by a nurse practitioner and registered nurses as well as by part-time physicians and a part-time nurse practitioner.

Services include acute and routine medical care, gynecological care, allergy injections, specialty referral, hypertension screening, tuberculosis testing and health education. A first aid station for the treatment of minor injuries is also open 8:00 a.m. to 11:30 a.m., Monday through Friday on the South Campus. In case of an emergency when the Health Service is closed, medical care is available on a 24 hour basis at the three local hospitals. Students requiring assistance from security are instructed to call 2666.

The University Health Service and the University are not responsible for students who become ill while on campus or who are injured while participating in class activities, university sports, or extra-curricular activities. Student accident insurance coverage for the academic year is obligatory and is included in the Student Activities Fee. Medical and surgical insurance, which is optional, is available at a nominal fee at the time of registration in September. Insurance claim forms may be obtained at both campus health offices and it is the responsibility of the student to complete these forms as soon as possible after an illness or accident. Failure to comply within the compulsory reporting period may result in the forfeiting of insurance claims. Hospitalization and medical treatment are obtained for a minor student only upon permission of the student's parents or guardians and at their expense. Emancipated students must assume responsibility for necessary hospitalization and medical treatment.

Any student, faculty, or employee incurring an injury at the University is advised to report to the Health Service for treatment. If the injury is sufficiently serious to warrant further medical attention, the nurse on duty shall make an appointment with a physician of the patient's choosing. It should be understood, however, that if it is necessary for the injured to be treated by a physician, the injured person, if not an employee of the Commonwealth, must assume the responsibility for payment of the physician's fee. Employees must file an accident report at the Personnel Office.

Mail Boxes And Postal Services

Student mailrooms are operated by the University of Lowell Associates, Inc., for the convenience of students. On the North Campus, the mailroom is located in the basement of Southwick Hall. The South Campus mailroom is located in the Basement of Mahoney Hall. Each student is assigned a mailbox during registration. Since incoming mail, administration notices, and faculty communications are placed in student mailboxes daily, *students are expected to check their mailboxes daily*. Mailroom facilities are made available to clubs and organizations for the purpose of distributing notices and advertisements, providing that such distribution is made by club personnel rather than by mailroom employees. Mailroom hours on both campuses are from 8:30 am to 12:00 noon and from 1:00 pm to 4:30 pm. The Mailroom will not receive items for distribution after 4:00 pm.

Placement Services

University Placement Services include dissemination of vocational information and career interviewing services. The Office, located in Southwick Hall, advises students on employment opportunities and arranges for employers, representatives from business, industry, government, hospitals, schools, and other areas to visit the

campus during the year to interview prospective graduates. A basic resource library in the Office provides occupational information, industrial literature, graduate school information, and self-help career aids. The credentialing service provided by the Office affords a place for each student to establish and maintain an up-to-date file of personal records, a developmental resume, letters of recommendation, and other supportive documentation. Copies of student credentials are sent to prospective employers upon their request or when initiated by the candidate.

Activities conducted by the University Placement Services include the following: letter writing clinic, resume writing clinic, salary negotiations, travel-business etiquette success seminar, full and part time job placement, graduate placement, company and agency personnel planning, business agency tours, and guest speaking services.

The Placement Office also provides information concerning teacher certification requirements for students who plan to teach in the public schools. However, students enrolled in an approved program of teacher education should inquire at the Office of the Dean, College of Education, concerning certification procedures.

General Policies Concerning Placement Credentials

1. Upon registering with the Placement Office, each senior receives appropriate forms which he or she must complete for his or her placement file and supplies the Placement Office with the names of three faculty members who have agreed to write letters of recommendation for forwarding to prospective employers or to graduate schools. Recommendation forms are sent directly to specified faculty members. For each recommendation desired, the registrant must complete a form which indicates the purpose of the requested recommendation (i.e. graduate study or job placement) and specifies the subject area of graduate study or the nature of the employment sought. In order to assist faculty members in focusing their letters of recommendation, this form will be sent to designated members of the faculty at the time when recommendation forms are forwarded from the Placement Office.
2. The Placement Office will not honor requests of registrants to reveal the contents of confidential letters of recommendation or evaluation reports which are on file and for which the student has waived his or her right to inspect. Registrants may request faculty members to make known their recommendations and evaluations prior to submission to the Placement Office. Since a faculty member is free to refuse such a request for disclosure as a condition for writing a letter of recommendation, the registrant should decide if he or she will require disclosure prior to asking a faculty member for a letter of recommendation. Students should report to the Placement Office only the names of faculty members who have their confidence and who have agreed to any disclosure which they may require. In the event that a registrant wishes to have a recommendation or evaluation removed from his or her placement file, the registrant should notify the placement secretary in writing. A recommendation or evaluation which has been removed from an individual's file upon his or her written request will be returned directly to the author or will be destroyed in the event that the author is no longer an employee of the University.
3. Placement papers will be sent only to bona fide employers at their professional or business addresses or to recognized admission officers of colleges and universities.
4. Any attempt by a registrant to gain access to his or her confidential placement papers through fraudulent means will result in automatic cancellation of placement privileges. In the event of such cancellation, all confidential letters will be returned to authors (or will be destroyed) and non-confidential materials will be returned to the registrant.
5. Until such time as a registrant revokes his or her authorization in writing, an individual's signature on documents filed with the Placement Office shall be considered as written authorization to forward all documents which comprise his or her complete placement file to any bona fide employer or recognized admission officer.

RIGHT OF ACCESS TO STUDENT RECORDS

The Family Rights and Privacy Act of 1974 grants any student in attendance, or former student, the right of access to inspect or review his or her educational files, records, or data. Students who wish to inspect their records must file a "Right of Access" form with the office or department in which the desired record is kept. Right of Access forms are available in the Office of Student Affairs. Within ten days of receipt of the Right of Access form, the office or department will notify the student as to the date, time, and location when the desired record will be available for inspection.

The University maintains the following general records on students:

Admission File	Admissions Office, Dugan Hall, South Campus
Permanent Academic Records	Registrar's Office, Southwick Hall, North Campus
Financial Aid Records	Financial Aid Office, Student Union, South Campus
Health Records	Health Services Building, North Campus
Temporary Academic Records	College Dean, Department Chairperson, or Faculty Advisor
Account and Payment Records	Business Office, Dugan Hall, South Campus

The file of each student must contain a record of all non-University affiliated individuals or organizations requesting access to it plus statements which specify the legitimate educational purposes for which access was requested. The Record of Access may be released only to University personnel or to state or federal officials as a means of auditing the reporting of access to student records.

Information or records concerning individual students may not be released to any individual or agency without written permission of the student. Any request for such information received without such written notice will not be honored and will be returned with a request for a written release by the student.

Educational records may be released without permission to the following individuals or agencies under the following specific conditions:

1. Personnel of the University, i.e. faculty, administrators or staff for legitimate education interest only;
2. Officials of other institutions in which the student is enrolled provided that the student is notified of the release;
3. Federal or state officials in connection with the audit and evaluation of federally funded programs or in connection with the enforcement of federal legal requirements which relate to such programs or in connection with the student's application for or receipt of financial aid;
4. State and local officials pursuant to any state statute adopted prior to November 19, 1974;
5. Organizations conducting studies for the purpose of developing predictive tests, administering student aid programs and improving instruction;
6. Accrediting organizations in order to carry out their accrediting functions;
7. Parents who claim the student as a dependent on their IRS statement; and
8. When necessary in an emergency, to protect the health, safety or welfare of the student or others, to persons who are in a position to deal with the emergency.

The following data is considered informational in nature and may be released, without permission of the student, at the discretion of the University: name, address, telephone listing, date and place of birth, participation in officially recognized activities and sports, height and weight of athletic team members, dates of attendance, degrees and awards received, and most recent previous educational institution attended. Any student who believes that his or her records are inaccurate or misleading may request a hearing with the Office of Student Affairs to discuss the contents of such records. Additional information on procedures or policies relating to University compliance with the Family Rights and Privacy Act can be obtained from the Office of Student Affairs.

UNIVERSITY BOOKSTORE

The University Bookstore is operated by the University of Lowell Associates, Inc. The North Campus bookstore is located in the basement of Falmouth Hall. The bookstore for the South Campus is located in the basement of Coburn Hall. All required textbooks (as well as instructional supplies, drafting equipment, calculators, art supplies, teaching aids, and general and technical reference books) are carried in both stores.

UNIVERSITY ACADEMIC POLICIES

Each University student is subject to two sets of academic regulations—those of the University as a whole, which are cited below, and the academic rules of the college and program in which he or she is enrolled. The academic rules of colleges and programs are listed in chapters devoted to college programs.

Students who have questions about the interpretation or application of University academic policy should consult the Dean of their College or the Registrar.

BACCALAUREATE DEGREES

Undergraduate programs which are offered by the University of Lowell lead to one of the following degrees: Bachelor of Arts, Bachelor of Fine Arts, Bachelor of Science, Bachelor of Music, Bachelor of Science in Business Administration, Bachelor of Science in Industrial Management, Bachelor of Science in Engineering, and Bachelor of Science in Technology.

Bachelor of Arts Degree

Curricula leading to the Bachelor of Arts degree are designed to provide a broad, comprehensive education with many options for developing major and minor programs. These options are specified by each of the colleges offering Bachelor of Arts degree programs and are sufficiently flexible to satisfy the individual needs of students while also providing sufficient preparation in the major field for subsequent specialization at the graduate level or for state certification of public-school teachers. All Bachelor of Arts degree programs require completion of a major within the college in which the student is a degree candidate and (except as specified by policies concerning second majors) a minimum of 75 credits outside the major field. The following is a listing of major fields in which the Bachelor of Arts degree is presently offered.

College of Education
Elementary Education*
College of Management Science
Economics
College of Music
Music (General)
College of Pure and Applied Sciences
Chemistry
Environmental Sciences
*Program terminates with the Class of 1985

College of Liberal Arts
American Studies
Art
English
History
Modern Languages
Philosophy
Political Science
Psychology
Sociology
Spanish

Bachelor of Science Degree

The Bachelor of Science degree is designed to provide students with a broad scientific education with specialized training in one or more of the basic sciences (e.g., biological sciences, mathematics, meteorology, etc.) or to combine a general education with a specialized applied program (e.g., health education, nursing, the administration of law & justice, etc.). Curricula which are offered in areas of the pure and applied sciences and mathematics provide opportunities for major and minor programs options but afford greater opportunities for major specialization than are permitted in comparable Bachelor of Arts curricula. All Bachelor of Science degree programs require completion of a major within the college in which the student is a degree candidate and a minimum of 50 credits outside the major field. The following is a listing of major field in which the Bachelor of Science degree is presently offered.

College of Health Professions
Health Education
Health Services Administration*
Clinical Laboratory Sciences
Nursing
Physical Therapy
College of Liberal Arts
Public Service: Administration of Law & Justice
*Program terminates with the class of 1985

College of Pure & Applied Sciences
Biological Sciences
Chemistry
Computer Science
Environmental Sciences +
Mathematics*
Meteorology
Physics#
Radiology Health Physics
+ Geology option available
*Options available in Applied or Pure Mathematics,
Computer Programming and Mathematical Statistics
#Options available in Optics and Applied Physics

OTHER BACCALAUREATE DEGREES

Bachelor of Fine Arts, Bachelor of Music, Bachelor of Science in Business Administration, Bachelor of Science in Industrial Management, Bachelor of Science in Engineering, and Bachelor of Science in Technology degree programs have been determined by the requirements of specific career objectives and are subject to the recommendations of such professional associations as the National Association of Schools of Music and the Accreditation Board for Engineering & Technology. Course requirements for these professional degree programs are specified in terms of the total course of study and without reference to academic options which are available to students under Bachelor of Arts and Bachelor of Science degree programs.

GENERAL DEGREE REQUIREMENTS

To qualify for University degrees, baccalaureate candidates are required to obtain 2.00 ("C") averages in their total courses of study, to present a minimum of 120 semester credits, to fulfill the minimum residency requirement which is designated for University day courses and each major, to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating, to complete all curriculum requirements specified by the college in which they are enrolled and by the department(s) in which they are majoring, and to complete the University Core Requirements.

University Core Requirements (Graduating Classes of 1983-1986)

The following Core Requirements are applicable to the graduating classes of 1983, 1984, 1985 and 1986. Beginning with the class of 1987 (entering the University in September 1983) and for subsequent classes, new Core Requirements will be in effect for all students.

The University Core Requirements consist of a Physical Activities Requirement (*course credits of which do not apply to the minimum degree requirement*), an English Composition Requirement, and Area Distribution Requirements.

Physical Activities Requirement (2 semester credits)

All students must successfully complete one year of supervised physical activity. Students who fail to satisfy the requirement of the physical activities program by the end of the freshman year must repeat failed courses until such time as they have passed them. Grades for physical activities courses are awarded on a "pass-no credit" basis ("P" or "NC") and are not computed in cumulative averages. Students who have not passed the physical activities requirement by the end of their senior year are advised that graduation will be denied until such time as the requirement is satisfied.

A waiver of this requirement will be granted in the following cases:

- (a) Students who participate in intercollegiate (varsity) athletics;
- (b) Students who are veterans;
- (c) R.O.T.C. students who successfully complete summer field training;
- (d) Students physically unable to participate in supervised activity may have the requirement waived upon written confirmation of limitation by a physician.

English Composition Requirement (6 semester credits)

All students must pass a sequence of two courses totaling six semester credits in English Composition (normally to be taken during the freshman year) unless they are specifically exempted in whole or in part by the English Department on the basis of a written proficiency examination.

Area Distribution Requirements (27 semester credits)

All students must select and pass a minimum of nine courses and twenty-seven semester credits outside their major departments* in three basic areas of the liberal arts and sciences. A minimum of two courses and six

semester credits must be presented in *each* of the three areas and an additional three courses and nine semester credits must be presented from *among* the Area Distribution Requirements. Students may not present more than three courses and nine semester credits from the offerings of any one department, may not present more than two courses and six credits from the offerings of the English Department, and may not present more than four courses and twelve semester credits in any one distribution area.

*Students pursuing double majors within the enumerated departmental areas are required to complete the Area Distribution Requirements outside *one* of their two major departments. However, such students may not present courses for a distribution requirement which may be elected for either of their major areas. For instance, a student who majors in English and Spanish may present other language or literature courses which are offered by the Department of Languages to satisfy the Area II Requirement but may not present English or Spanish courses.

Area I

Behavioral and Social Sciences +

Economics, Geography (non-laboratory courses), History, Political Science, Psychology, and Sociology.

Area II

Fine Arts and the Humanities#

Art, English (excluding 42-101 and 102), Languages, Music, and Philosophy

Area III

Mathematics and the Sciences

Astronomy, Biology, Chemistry, Earth Sciences (Geography laboratory courses, Geology, Meteorology), Mathematics, and Physics

+ 59-203 & 59-204: Technology & Human Values I & II may be presented for the Area I Distribution Requirement.

#59-201 & 59-202: Western Cultural Heritage I & II may be presented for the Area II Distribution Requirement.

University Core Requirements

(Graduating Class of 1987 and Subsequent Classes)

The following Core Requirements are in effect for the class of 1987 (entering the University in September 1983) and for all subsequent classes. Students transferring to the University will be subject to the requirements in effect for the class in which they are accepted for transfer. Students who transfer into the class of 1987 and subsequent classes are subject to these requirements without regard to the beginning date of their collegiate studies at another institution. Students who began their baccalaureate study at the University of Lowell prior to 1983 under the previous Core Requirement and who have been absent from the University for two or more continuous semesters are subject to the revised requirements specified below. (Cf. "Qualified Reinstatement" in the Admissions section of this bulletin). The Physical Activity Requirement (Cf. above) is under review but remains in effect unless revoked by the Board of Trustees.

The University Core Requirements consist of (1) a demonstration of competence in written English, (2) an area distribution requirement, and (3) a familiarity with problems and issues of value and choice.

English Composition Requirement (6 semester credits)

All students must pass a sequence of two courses totaling six semester credits in composition (College Writing I and II, normally taken in freshman year) unless they are specifically exempted in whole or in part by the English Department on the basis of a written proficiency examination.

Area Distribution Requirements (27-29 semester credits)

All students must pass a minimum of nine courses (a total of twenty-seven to twenty-nine semester credits), outside their major department according to the following distribution:

- (1) A minimum of two courses and six semester credits must be presented in each of Area I and Area II, plus two additional courses (six semester credits) selected from either or both of these areas. Total: six courses, eighteen semester credits.

(2) A student also must present a minimum of three courses (nine to eleven semester credits) in Area III; one course must be in a laboratory science (or its equivalent), a second must be in Mathematics, and a third course shall be in either science or Mathematics. Total: three courses, nine to eleven semester credits.

(3) A student whose academic major falls in a discipline specifically listed under Area I, II, or III, or whose professional major is cognate with one of these disciplines, is exempted from the distribution requirement for courses in that area.*

(4) A student must satisfy distribution requirements by passing courses selected from an approved list.**

(5) In fulfilling the distribution requirement, a student is limited to a maximum of two courses in any one department. Additionally, a student is limited to two courses in literature, irrespective of departmental listing.

*Students pursuing a double major, both of which are in a discipline specifically listed under Area I, II, or III, are required to complete the area distribution requirement outside of one of their two major departments.

**An approved list of courses available for the next semester will be published prior to registration for that semester.

Human Values Requirement (3 semester credits)

All students are required to pass one human values core course which emphasizes the values and processes that lead to the making of ethical and humane decisions. Except for courses designed by departments or programs to meet this requirement and *which shall be required for and restricted to majors only*, a student shall satisfy this requirement by passing a course selected from an approved list.**

**An approved list of courses available for the next semester will be published prior to registration for that semester.

Residency Requirements

All baccalaureate degree candidates must satisfy both general and major field residency requirements.

General Residency Requirements

All candidates for baccalaureate degrees, exclusive of degree candidates in the Evening School of Continuing Education, must complete 60 semester credits at the University of Lowell, 30 of which must be earned through full-time study in University day courses.* The following residency options apply, as specified, to candidates for regular baccalaureate degrees:

1. Complete three years in the University, earning not less than 90 credits (30 of which must be earned through full-time study in University day classes), and an approved junior or senior year program at another accredited baccalaureate institution, earning not more than 30 semester credits or the number of semester credits which is specified for juniors or seniors by those prescribed courses of study which are listed in the applicable issue of the *Bulletin of Undergraduate Studies*;
2. Complete an associate degree in the University of Lowell Evening School of Continuing Education or, under the provisions of the Massachusetts Transfer Compact, in a Massachusetts Community College and the last two years in the University, earning not less than 60 credits (30 of which must be earned through full-time study in University day courses);
3. Complete up to the first two years in an accredited institution, earning not more than 60 semester credits, with grades of "C" (2.0 on a 4.0 scale) or better, and the remaining years in the University, earning not less than 60 credits (30 of which must be earned through full time study in the University day courses);
4. Complete up to the first three years of a baccalaureate program in an accredited four-year institution, earning not more than 90 semester credits, with grades of "C" (2.0 on a 4.0 scale) or better, and the remaining year(s) in full time study in University day classes, earning not less than 30 credits; or

5. Complete up to the first three years of a baccalaureate program in the University of Lowell Evening School of Continuing Education and the remaining year(s) in full-time study in University day classes, earning not less than 30 credits.

The requirement of 30 semester credits of full-time study in University of Lowell day courses may not be satisfied through course equivalency procedures. However, residency requirements over and above this requirement may be satisfied subsequent to admission to the University through these procedures.* Upon the approval of the appropriate college dean, up to 15 credits of the minimum day course requirement also may be satisfied through completion of day courses in the University of Lowell Summer School. Students who are interested in petitioning for application of day courses of the University of Lowell Summer School to the minimum day class requirement must file an academic petition with the dean of the college to which they have been admitted as degree candidates prior to enrolling for Summer School courses.

*Students who matriculate part-time for degrees under provisions of the Second Chance Program for Adults must satisfy requirements in University day classes as specified (including the requirement for the major specified below) but may fulfill these requirements on either a full-time or part-time basis. An individual who has been admitted to day courses of the University as a non-matriculating student is not considered a student in residence and such an individual who is subsequently admitted as a matriculating student must petition the dean of the college to which he or she has been admitted for recognition of non-matriculated courses. Up to 15 credits of non-matriculated day courses may be recognized for application to the minimum residency requirements of 30 credits of University day courses.

+ Cf. regulations which appear elsewhere in this publication under the heading "Course Equivalency Examinations." Note that specific restrictions apply to students who transfer to the University.

Residency Requirement for Major Fields

Each baccalaureate degree candidate must complete at least 15 credits in regular class work within major departments of the University for each major which is presented for a degree. Upon the approval of the appropriate college dean, the course requirement of 15 credits within major departments for each major pursued may be satisfied through satisfactory completion of day courses in the University of Lowell Summer School. Students who are interested in petitioning for application of day courses of the University of Lowell Summer School to the 15 credit major requirement must file an academic petition with the dean of the college to which they have been admitted as degree candidates prior to enrolling for Summer School courses.

DUAL DEGREE PROGRAM: Bachelor of Arts and Bachelor of Science in Engineering.

Students who wish to pursue the dual degree program in the College of Liberal Arts and the College of Engineering must establish simultaneous matriculation in both colleges and designate candidacy for two degrees. The curricula for dual-degree programs are approved by participating college faculties and must be completed as prescribed. It is therefore imperative that a student who wishes to pursue an approved dual-degree program obtain a copy of the specified curriculum which enumerates the specific semester-by-semester course requirements.

Students interested in this program should direct their inquiries to the office of the Dean of the College of Liberal Arts or the Dean of the College of Engineering.

Students should consult the regulation concerning the declaration of a second major which appears elsewhere in this publication under the heading "Major Field Requirements" if they wish to pursue a second major.

MAJOR FIELD REQUIREMENTS

Candidates for Bachelor of Arts and Bachelor of Science degrees must complete an academic major within the college in which their degrees will be granted. The requirements for majors are set by departments of the University or interdisciplinary committees but must specify a minimum of 30 credits and at least 15 credits in the upper-division course level (300 and 400 numbered courses).

Candidates for the Bachelor of Arts degree may not be required to take more than 45 credits in their major fields, but they may elect to take additional courses in the major beyond the specified maximum providing that such additional courses are not presented for the minimum degree requirement of 120 credits. Accordingly, major credits

which exceed the specified maximum will raise by an equal amount the number of minimum credits which are required for the Bachelor of Arts degree.

Candidates for the Bachelor of Science degree may not be required to take more than 60 credits in their major fields, but they may elect to take additional courses in the major beyond the specified maximum providing that such additional courses are not presented for the minimum degree requirement of 120 credits. Accordingly, major credits which exceed the specified maximum will raise by an equal amount the number of minimum credits which are required for the Bachelor of Science degree.

Declaration of Major

Students who have declared a major at the time of their admission to the University are officially enrolled in the college in which their designated major is offered and are referred by the college dean to the chairperson of their designated major for assignment of a faculty advisor. Although the University does not require students to declare their major fields until they have achieved 60 semester credits, an early decision by students will greatly facilitate the selection of appropriate prerequisite courses for major fields and accordingly will reduce the possibilities of time-consuming errors in judgment. Students enrolled in the College of Pure & Applied Sciences must declare their major fields by the end of the freshman year. Students contemplating majors in chemistry or environmental sciences should initiate prerequisite course work immediately upon entrance to the College of Pure & Applied Sciences and should make a declaration of major at this time or prior to the end of the freshman year. Students in the College of Health Professions should not delay declaration of major beyond the freshman year. Additional course work beyond the minimum degree requirement and extension of the normal four-year period of study may be expected when individuals make a declaration of major later than advised above.

Students who make no declaration of major prior to the end of their sophomore year are listed as undeclared students for their first two years. Individuals who wish to designate a major which is offered by the college in which they are enrolled as undeclared students must secure the signature of the appropriate department chairperson (or the chairperson of the committee which exercises jurisdiction over an interdepartmental major) on a declaration of major form and must file the completed form with the Office of the Registrar. Individuals who wish to designate a major which is not offered by the college in which they are enrolled as undeclared students must file and approved form for intercollegiate transfer and declaration of major with the Office of the Registrar. This form requires the signatures of the dean of the college to which the student transfers and the appropriate department chairperson.

Undeclared students are advised that openings may be limited or unavailable in some programs and that differential admissions criteria may be applied to program or college applicants when staffing or facilities render it necessary to establish limitations upon enrollments. Undeclared students may not apply for transfer to the College of Education, which requires the completion of specified lower-division courses in the major as one of several admission requirements.

Declaration of Second Major

Students who wish to declare a second major in an academic career field should consult with the dean of the college in which they are enrolled to ascertain if a second major in an academic career field can be completed within specified degree requirements or will require additional study beyond the minimum degree requirements and extension of the regular period of baccalaureate study. Students who wish to declare a second major in the college in which they are enrolled as degree candidates ordinarily may do so by filing an approved declaration of second major with the Office of the Registrar. Students who wish to declare such a major in another college of the University may do so only when regulations of that college and the college in which they are enrolled as degree candidates both permit and when such action is approved by the concerned college deans. Students who are permitted to carry two majors are assigned an advisor in each major department.

Individuals who are matriculating for the Bachelor of Arts degree may not count more than 63 credits in the two academic majors combined toward the minimum degree requirement of 120 credits. Students who present more than 63 credits in the two majors combined may not present less than 57 semester credits outside the two major fields in satisfying the minimum degree requirement of 120 credits. Accordingly, students who present more than 63 credits in the two majors combined must present a number of credits beyond the minimum degree requirement of 120 credits which is equal to the number of credits by which they exceed the combined major credit maximum.

Except as noted above under the heading "Dual Degree Program," students who elect academic majors in more than one college are candidates for one degree only and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary at the time they make a declaration of second major by filing for intercollegiate transfer. Accordingly, a student who pursues academic majors in two colleges is subject to all degree requirements as specified by the college of his or her initial academic major and is subject only to major course requirements (including collateral and prerequisite courses for the major) as specified by the department of his or her second academic major. Individuals who pursue majors which are offered within different degree requirements will receive the degree which is designated for their initial academic major unless they file for intercollegiate transfer at the time they file a declaration of second academic major.

Professional programs in business administration, education, engineering, health professions (health education, health-services administration, clinical laboratory sciences, nursing, and physical therapy), industrial management, industrial technology, and music (Bachelor of Music programs) may be designated as degree majors only. Although students in these programs may be permitted to pursue a second major in an academic field which is offered by another college, they are subject to all degree requirements as specified by the college of the professional major.

Change of Major

Once students have begun a program of major studies, they may change their major field only by filing an approved change of major form with the Office of the Registrar. Students who make substantial changes in their plans of study after the beginning of the sophomore year, regardless of major, ordinarily will find it impossible to complete degree requirements within the normal four-year period of study and may also find it necessary to redesignate their choice of degree. Students who have been placed on academic warning should review their choice of major and should contemplate a change of program.

Change of Major within College of Enrollment

Students who wish to change their declarations of major within the college in which they are enrolled as degree candidates are required to file an approved change of major form with the Office of the Registrar. This form requires the approval of the chairperson of the major department to which the student desires to transfer and should be filed by November 1 for spring semester approval and by April 1 for fall semester approval in order to insure proper advisement during the periods designated for fall and spring preregistration. Filing after the recommended dates may be permitted by the chairperson of the department having jurisdiction over the new major. Students anticipating a change of major may drop irrelevant courses if applicable University rules permit (cf., withdrawal through 40th class day and "Reduced Load Status.") The symbol "X" may not be assigned to courses which are dropped after the 40th class day because a student intends to change a major.

Change of Major with Intercollegiate Transfer

Students desiring to transfer from a baccalaureate program of the Evening School of Continuing Education to a baccalaureate day program,* to transfer from a baccalaureate day program to a baccalaureate program of the Evening School of Continuing Education, or to drop a major which is offered by the college in which they are matriculating and to add a major which is offered by another college of the University must apply for intercollegiate transfer.

An individual seeking an intercollegiate transfer must file a petition, together with a transcript of his or her permanent record card, with the appropriate chairperson and dean having jurisdiction over the program to which transfer is desired. Following endorsement by both the chairperson and the dean, this form must be filed with the Office of the Registrar by *November 1 for spring semester transfer and by April 1 for fall semester transfer. Individuals petitioning for intercollegiate transfer are required to satisfy the admissions requirements of their desired college and program and, irrespective of any favorable decision concerning such petition, they may not be permitted to transfer if they have been suspended from the University after they have been accepted for transfer.*

Individuals seeking transfer from one college to another are advised that openings may be limited or unavailable in some programs, that differential admissions criteria may be applied to program or college applicants when staffing or facilities render it necessary to establish limitations upon enrollments, and that the completion of degree requirements within the customary four-year period may not be possible since the correction of deficiencies cannot always be accommodated within the schedule of course offerings.

The official date of intercollegiate transfer is the first day of the semester following approval of a student's transfer application. Since course preregistration is conducted prior to the official date of transfer, students should make immediate arrangements for pre-registration counselling with the dean of the college to which they will transfer. Subsequent to approval of a student's application for transfer and prior to the official date of transfer, the college dean shall review the academic record of the student to determine the applicability of previously completed courses to the requirements of the college and, if appropriate, the new major.

The dean shall provide the student and the Office of the Registrar with a listing of such courses and shall authorize their deletion from the student's cumulative grade-point average. Irrespective of grades received, all courses which may not be applied to minimum college or program requirements for degrees shall be deleted from the student's cumulative grade-point average. For example, nursing courses, curriculum & instruction courses, and apprentice teaching courses are not applicable to curricula of the College of Liberal Arts and a student who has completed such courses will have them deleted from his or her cumulative average upon transfer to the College of Liberal Arts. Students who subsequently transfer to another college within the University, or who return to the college from which they have previously transferred within the University, shall have their academic records again reviewed and appropriate courses shall be reinstated to the cumulative average and inappropriate courses shall be deleted. *No student shall be permitted more than two intercollegiate transfers.*

* *Evening School students transferring to college programs should refer to policies under the heading "Residency Requirements" for specification of credits which must be completed in regular day classes.*

MINOR AREA REQUIREMENTS

The requirements for minors are established by University departments or by interdisciplinary committees. No minor program may consist of less than 18 semester credits in the minor field nor more than 24 semester credits. At least 6 credits must be completed at the upper-division course level for all minor studies. Students are advised that an aggregation of courses which total 18 or more credits does not constitute a minor field. Specific options for minor programs will depend on the major field which a student has elected to pursue and collateral course requirements which have been specified by major departments. Although minor programs generally may be elected without specific authorization of departments offering such programs, some minors do require such authorization. In any event, individuals who are interested in electing a minor program should consult the relevant section of this publication for curriculum requirements and prerequisites. Notation of a minor program is not made on the student's permanent record card until all degree requirements have been satisfied and the Office of the Registrar has been notified by the college in which the student has matriculated concerning the completion of minor programs.

LANGUAGE REQUIREMENT

Although the University does not require language proficiency as such for any degree, each faculty having jurisdiction over specialized program areas has the prerogative of specifying a level of language proficiency as a collateral requirement for major fields. Students who are required to evidence intermediate proficiency as a collateral requirement of their major studies and individuals who desire to present official evidence of language proficiency for purposes of employment or application to graduate schools may satisfy intermediate language proficiency through any one of the following options:

- a. a score of "550" or above on a College Entrance Examination Board Achievement Test;
- b. a score of "3" or above on a College Entrance Examination Board Advanced Placement Examination;
- c. a satisfactory score in a proficiency test prepared and administered by the Language Department of the University of Lowell (preferably during the student's freshman year) and covering a reading knowledge of any one of the following languages: French, German, Greek, Italian, Latin, or Spanish;
- d. passing two semester courses on the intermediate, second-year college level in a language previously studied in the secondary school and offered by the University of Lowell; or
- e. passing a minimum of 12 semester credits in one language, the study of which is initiated at the University of Lowell.

COOPERATIVE EDUCATION

The Cooperative Education Program integrates academic studies with productive work experience in business and industry and is available to all individuals whose major departments have agreed to permit their students to

participate in an alternating schedule of study and work. Since students generally are placed in employment related to their academic fields of study, the Cooperative Education Program not only provides a source of income which may help students to defray their college expenses but also tends to make classroom work more immediately relevant by clarifying career goals through personal experiences.

Full participation in the Cooperative Education Program ordinarily implies extension of the normal period of baccalaureate study to five years, entails three alternated working periods (fall, spring, and summer) with participating employers, and required individual commitment to a 40 hour work week during assigned working periods. A maximum of 3 credits per working period (up to a total of 9 credits) may be granted to participating students upon authorization of appropriate major departments. Depending upon departmental policies, these credits may satisfy unrestricted elective course requirements.

When on cooperative education assignment, a student remains registered at the University by means of required seminars and is required to pay student union and student activities fees. Additional information concerning the requirements for program participation may be secured from the Office of Cooperative Education.

UNDERGRADUATE CLASSIFICATION

Irrespective of the provisions of specific curricula and the number of full-time semesters completed by students, the Office of the Registrar determines class standing at the end of each semester on the basis of total credits earned (including physical activities and aerospace studies credits) and in accordance with the following scales:

Freshman standing	0-29 semester credits
Sophomore standing	30-59 semester credits
Junior standing	60-89 semester credits
Senior standing	90 or more semester credits (to graduation)

MAXIMUM PERIOD OF BACCALAUREATE STUDY

Depending upon the nature of the subject and discipline, courses taken by a student may become obsolete for curricula of the University when they have been completed over a period of time which exceeds the customary period for baccalaureate study. Accordingly, University departments reserve the right to delete courses from a student's program of study when such courses have been determined to be obsolete for the curriculum in which the student is enrolled.

Ten full-time semesters is the maximum period which is permitted for continuous University matriculation unless special permission for additional semester enrollment has been granted by the dean of the college in which a student is enrolled as a degree candidate. A student who fails to complete degree requirements within ten full-time semesters may be dropped from the University when instructional resources render it necessary to establish limitations upon enrollments.

COURSE EQUIVALENCY EXAMINATIONS

Subject to specified policies of academic departments, unusually qualified degree candidates are given the opportunity to demonstrate their special competencies and to receive University credit for such competencies through established course equivalency procedures without having to fulfill classroom or faculty course requirements. Matriculating students may demonstrate their special competencies through subject examinations of the College Level Examination Program and through departmental equivalency examinations. Credits which are granted through course equivalency procedures are noted on the student's permanent record card. However, no grades for equivalency examinations are recorded and such examination credit as may be granted is not computed for determining grade-point averages.

The purpose of course equivalency procedures is to provide credit for existing competencies—that is, those competencies which students possess prior to their applications for equivalency credit and prior to their registration for a University course. *Students may not receive credit for a specific proficiency examinations if they have registered at the University in the course which that examination represents, if they have previously received a University grade for that course or a course in sequence above the course for which they wish to take the examination, or if they have previously received transfer credit for an equivalent course taken at another institution.* Credit for general examinations of CLEP may not be granted to students after their admission to the University

as matriculating students. University departments reserve the right to refuse the granting of credit by examination for those courses which are presented by a student for his or her major(s) and to deny recognition of previously granted credit for students who prior to their declaration of major field have received equivalency credit in the subsequently declared major.

Subject to the additional limitations of the college and program in which the student is enrolled, the maximum number of credits which a matriculating student may earn through course equivalency procedures is 30 semester credits. Students who have transferred to the University may not apply for equivalency credit in excess of a number which is determined by subtracting all course equivalency and transfer credits which are accepted by the University from the maximum of 90 credits which is permitted for both transfer and equivalency credit. Nor may transfer students present equivalency credits in fulfillment of the major field residency requirement of 15 credits in University courses or the general residency requirements of 30 credits in University day courses. (Cf. "Residency Requirements.")

College Level Examination Program (CLEP)

Students who are interested in taking subject examinations of the College Level Examination Program should secure petition forms from the Office of the Registrar which will permit matriculating students of the University to arrange for administration of CLEP tests. Approved forms must be filed with the Office of the Registrar. Application to take approved subject examinations of the College Level Examination Program may be made at the Office of Continuing Education or other CLEP testing center. CLEP tests are administered at the University during the third week of each month. Course credit through the subject examinations of CLEP will be granted only if an examination has been approved by an individual's faculty advisor and the chairperson of the department which offers the course for which the CLEP test is a substitute and the score attained by the individual is equal to or better than the minimum score for an examination specified in the table below.

Although students are advised to secure the above authorizations prior to taking a CLEP test in order to avoid rejection of a request for credit after a test has been taken, such authorization may be solicited after completion of a test. CLEP tests in subjects not listed below will not be recognized for university credit. The following is a list of CLEP tests for which credit will be granted.

CURRENT TESTS	Minimum Score for Awarding Credit	University Credits Granted
Accounting, Introductory	47	6
Afro-American History	49	3
American Education, History of	46	3
American Government	47	3
American History	46	6
American Literature	46	6
Biology, General	46	6
Business Law, Introductory	51	3
Calculus with Elementary Functions	47	6
Chemistry, General	47	6
College Algebra	45	3
College Algebra- Trigonometry	45	3
College Composition	47	3
College French (Levels 1 and 2)		
Second Semester	41	6
Fourth Semester	53	12
College German (Levels 1 and 2)		
Second Semester	40	6
Fourth Semester	48	12

CURRENT TESTS	Minimum Score for Awarding Credit	University Credits Granted
College Spanish (Levels 1 and 2)		
Second Semester	41	6
Fourth Semester	50	12
Computers & Data Processing	47	3
Computer Programming Elementary-FORTRAN IV	48	3
Educational Psychology	46	3
English Literature	46	6
Human Growth & Development	45	3
Literature, Analysis and Interpretation of	49	3
Macroeconomics, Introductory	48	3
Microeconomics, Introductory	47	3
Psychology, General	47	3
Sociology, Introductory	47	3
Statistics	49	3
Tests & Measurements	46	3
Trigonometry	50	3
Western Civilization	50	6

Departmental Examinations

Students who are interested in taking departmental examinations may obtain applications for such examinations from the Office of the Registrar as any time during the fall and spring semesters, but they must initiate the ap-

plication process in sufficient time to permit the completion of examinations and the processing of examination results prior to the final deadline for filing course grades during the semester in which they are examined. Applications for departmental course-equivalency examinations are filed with the appropriate faculty examiner after approval by the student's advisor, his or her major department chairperson, the chairperson of the department in which the examination is to be administered, and the faculty examiner.

Students may not repeat departmental equivalency examinations and, except for documented medical reasons or personal emergencies, they may not reapply for such examinations in the event that they fail to keep an examination appointment. Examinations must be wholly or substantially written unless the nature of the course makes more appropriate an oral or performance examination. Departments may authorize instructors to administer end of semester examinations which are scheduled during the final examination period when such examinations are adequate measures of total course requirements. After the student has completed an authorized examination, the faculty examiner must file his or her recommendation for course credit with the Office of the Registrar by the final deadline for filing semester grades.

PROGRAMS OF STUDY AND DECLARATIONS OF INTENT TO GRADUATE

All students are required to file with their advisor a copy of their final semester course registrations (including notification of course withdrawal) and an accurate account of courses taken, grades received, and changes of contemplated programs of study. Deadlines for conferring with faculty advisors concerning the completion of degree requirements and for filing final programs of study and declarations of intent to graduate with college deans are specified by the University calendar.

Individuals who unofficially complete all degree requirements and fail to file for a degree must reapply for readmission through the Office of Admissions. Upon the payment of admission and graduation fees, such individuals may apply for degrees through their department chairpersons and college deans.

Each college has adopted a program of studies form which best reflects the nature of its degree programs. Forms which are employed by the College of Liberal Arts, the College of Education, and the College of Health Professions have been standardized and designate three areas: University Core Requirements, Major Requirements, and Collateral Programs (Second Majors, Minors, and Unrestricted Elective Courses).

Credits for each course may be counted only once in a student's program of studies form and may not be counted for more than one category of the program of studies. A course which is specified as a requirement for both a student's major and minor will satisfy both requirements, as stated, but such course credits may be counted for the major only. Irrespective of such overlapping courses, a minimum of 18 credits must be listed for each minor area designated. A course which is specified as a common prerequisite for several courses will satisfy all prerequisite requirements, as stated, but course credits may not be counted more than once and may be applied to one category of a student's program of studies only.

At the end of the semester following the filing of a declaration of intent to graduate, the office of the college dean verifies course completions and required cumulative and major averages. The names of students who have satisfied all degree requirements are then forwarded to the appropriate college faculty for endorsement and, finally, to the Board of Trustees, who officially confer degrees upon recommended individuals. *Students who unofficially complete all degree requirements and fail to file a declaration of intent to graduate shall not be recommended to the Board of Trustees and the conferral of the degree shall be delayed until an approved declaration has been filed.*

UNIVERSITY COMMENCEMENT

Graduation exercises are held once a year at the end of the spring semester. Undergraduates who have completed degree requirements during the previous summer term or fall semester are permitted to attend commencement exercises and their names are listed in the commencement booklet. Attendance of commencement exercises is not compulsory but all seniors are required to pay the specified graduation fee, which covers the cost of the diploma, academic attire, and incidental graduation expenses. Students who do not elect to attend commencement ceremonies may not be granted a refund of the commencement fee. *An individual who wishes to receive a diploma by mail must file a corrected address with the Office of the Registrar if he or she anticipates moving from a previously reported permanent address.*

CONFERRING OF DEGREES

The Board of Trustees votes degrees three times a year: (1) for students completing degree requirements during the spring semester, (2) for students completing degree requirements during the summer term, and (3) for students completing degree requirements during the fall semester. Individuals who wish to submit verification of degree completion to employers or to graduate schools during the period between the end of their final grading period and the conferring of degrees may obtain a letter of completion from their college dean. *Duplicate diplomas are not issued for any reason.*

ACADEMIC HONORS

Academic honors are of three types: University honors, honors in major fields, and semester honors. Students enrolled in all colleges may qualify for University and semester honors. Honors in major fields are awarded at the option of the major departments.

University Honors

The University recognizes graduates who have attained exceptional scholastic distinction. To be eligible for such recognition a student must achieve a minimum grade point average of 3.00 for all courses completed at the University (or through its auspices under regulations which govern authorized off-campus course work) and must have earned a minimum of 60 semester credits at the University as *upperclass* students. Additionally, the record of each student must qualify him or her for the percentile distributions cited below as applied by each college to its total number of graduating students.

Summa Cum Laude	99th through the 98th percentiles
Magna Cum Laude	97th through the 90th percentiles
Cum Laude	89th through the 75th percentiles

University honors are officially entered on the permanent record cards of students.

Honors in Major Fields

In addition to honors which are awarded by the University, honors in major fields may be awarded by the colleges in which students are enrolled or (in the case of continuing education students) by the colleges which exercise academic jurisdiction over the programs in which they are enrolled. Recommendations for such honors are made by the faculty of the student's major department (or by interdisciplinary committees which exercise academic jurisdiction over the student's major studies) for outstanding achievement in the major field. In order to qualify for such honors, the student must fulfill the following requirements:

- Complete a minimum of 24 credits in the major field at the University of Lowell;
- Fulfill any honors requirements as specified by colleges, departments, or interdisciplinary committees in the major field; and
- Achieve a grade-point average as specified below:
 - High Honors 4.00 in all courses which are taken in the major field at the University of Lowell;
 - Honors 3.50 to 3.99 in all courses which are taken in the major field at the University of Lowell with no course grade in such courses less than "B".

Honors in the major field are noted on the permanent record cards of students.

Semester Honors (Dean's List)

At the end of the fall and spring semester, the dean of each college issues a list of students who have achieved distinguished semester records. This list recognizes students who have completed full-time programs (at least 12 credits of which must have been qualitatively graded) with no grade less than "B".

GRADING POLICIES

The following qualitative letter grades are employed by faculty members to characterize the quality of a student's work in a course: "A", "AB", "B", "BC", "C", "CD", "D", and "F" and respectively carry quality points of 4.00, 3.50, 3.00, 2.50, 2.00, 1.50, 1.00, and 0.

"A"	designates that the work done by the student is superior and is of the highest honors quality;
"AB"	designates that the work done by the student is less than superior but is completed with the level of distinction which is higher than the basic honors level;
"B"	designates that the work done by the student is of basic honors quality;
"BC"	designates that the work done by the student is less than honors quality but is better than satisfactory;
"C"	indicates satisfactory work which conforms to the general expectations of the University for baccalaureate study;
"CD"	indicates that the work done by the student is less than satisfactory and below graduation standard but is better than the minimum requirement for passing a course;
"D"	indicates work which meets the minimum requirement for passing a course;
"F"	designates course failure.

In addition to the above qualitative letter grades, the following symbols also are used to designate special enrollment provisions or course statuses and do not affect the student's academic average:

"P"	designates completion with credit of an unrestricted elective or physical activities course which was taken on a "pass-no credit" basis;
"NC"	indicates failure of an unrestricted elective or physical activities course which was taken on a "pass-no credit" basis;
"S"	designates satisfactory completion of a practicum experience course with a final course grade of "C" or higher;
"U"	indicates unsatisfactory performance in a practicum experience course with a final course grade of less than "C";
"I"	indicates a course which has not been completed;
"AU"	designates that the student has registered for a course on an "audit" basis and has maintained an attendance record throughout the semester which is sufficient to warrant an official recognition of course attendance;
"W"	designates student withdrawal from the University prior to the 41st class day of a semester or from a course during the period from the 10th to the 40th class day;
"X"	designates student withdrawal after the 40th class day of a semester for administratively approved reasons of an emergency or medical nature; and
"Y"	designates administrative dismissal for other than academic reasons.

Pass-No Credit Course Registration

Students may elect to register on a pass-no credit basis for a maximum of four unrestricted elective courses. A student may not change his or her enrollment status from letter grade to pass-no credit or from pass-no credit to letter grade after the established deadline for adding a course. A pass-no credit course cannot be presented in fulfillment of University Core Requirements, major programs, minor programs, or specifically designated courses of an established curriculum. A grade of "P" indicates that a student's performance merits an evaluation of "D" or better. "NC" indicates that a course has been failed but that such failure is without prejudice to the student's cumulative average. Although appropriate credits are granted to students when grades of "P" have been assigned, these credits are not qualitatively weighted and hence do not affect a student's academic average.

Satisfactory-Unsatisfactory Course Registration

Certain courses (e.g., practicum experiences, advanced seminars, and directed studies) may be graded as satisfactory or unsatisfactory. A grade of "S" indicates that a student's performance merits an evaluation of "C" or better. "U" indicates a course evaluation of less than "C". Although appropriate credits are granted to students when grades of "S" have been assigned, these credits are not qualitatively weighted and hence do not affect a student's academic average. A grade of "U" indicates that attempted course credits have not been granted and is awarded without prejudice to a student's cumulative average.

Incompleted Courses

The letter symbol "I" (incomplete) is a temporary notation which is assigned for incomplete work in courses when the records of students have been satisfactory but for legitimate reasons a minor portion of their course work remains to be completed or when the course records of students justify the expectation that they will obtain a passing grade but for emergency reasons they have been absent from the final course evaluation. Any missed final examination or other final course evaluation requires a student explanation within 48 hours so that the instructor can file the proper course notation with the Office of the Registrar. *A student who has evidenced an unsatisfactory course record, who has failed to complete a major portion of an instructor's course requirements,*

or who fails to provide an instructor with a satisfactory reason for absence from a final examination or final course evaluation within the specified 48 hour period may not be assigned the letter symbol "I". Responsibility for making arrangements with an instructor to complete all outstanding course work rests entirely with the student, who must complete all course work in sufficient time to permit an instructor to file a final course grade no later than one month after the date on which the succeeding semester begins.

Permanent Course Notations

Instructors who file letter symbols of "I" also must file an end of course letter grade which will be assigned in the event that incompleting course work is not made up by the student prior to the established deadline. At the end of the official make-up period (or, in the event of a substantiated student emergency, at the end of an extended make-up period), the Office of the Registrar will convert the temporary notation of "I" to the appropriate permanent symbol. This permanent notation will be one of the following: (1) a letter grade which has been filed by an instructor during the grading period of the previous semester to designate the final course standing of a student who has failed to make up incompleting course requirements, (2) a letter grade which is filed by an instructor at the end of the make-up period to designate the final course standing of a student who has made up incompleting course requirements, or (3) the letter symbol "X" which the dean of the college in which the student is enrolled as a degree candidate may authorize, upon consultation with full-time course instructors, to designate that a student has withdrawn from the University after the end of the semester for documented reasons relating to a medical or personal emergency. (Cf. "University Withdrawal After the End of the Semester.")

Extension of Make-up Period

Limited extensions of the make-up period may be granted to students for serious medical reasons and for documented personal emergencies. Requests for such extensions are approved by the dean of the college in which students are enrolled as degree candidates and must be filed no later than one calendar week preceding the established deadline for instructors to submit final grades for incompleting courses. Except for extraordinary circumstances acceptable to a college dean, the maximum period for which an extension may be granted is the end of the semester following the assignment of "I" notations.

Audited Courses

A student may enroll in credit courses as an auditor with appropriate approval. Forms and instructions for registration as an auditor may be obtained from the Office of the Registrar. No charge is levied on full-time students for audited courses. No credit or grade will be recorded for an audited course, but the symbol "AU" may be listed on the permanent record card at the request of the course instructor when he or she judges that the student has exhibited satisfactory attendance. A change from auditor to credit status, or from credit status to auditor, may not be made after the deadline for adding a course.

Credit may not be earned in courses which have been audited except by re-enrollment in and completion of the course with a passing grade. Students who have audited a course subsequently may not earn credit in the same course through tests of the College Level Examination Program or through other authorized examination procedures for course challenge.

GRADE CHANGES

At the end of each semester, the Office of the Registrar mails a grade report to each student. This report constitutes official notification of grades received. All course grades become a part of the student's official record upon instructor assignment and may not be changed except as specifically provided by University procedures. Corrections of grade-point averages automatically are authorized when erroneous grade reports are corrected by instructors and when specific courses are deleted from grade-point averages under provisions of University regulations governing repeated failed courses, change of enrollment status as an intercollegiate transfer within the University, and expiration of degree credits.

Students who believe that mistakes have been made in assigning or recording course grades should notify instructors as soon as possible after receiving their grade reports but in no case at a time later than the deadline estab-

lished for making grade corrections. The deadline for instructors to correct an erroneous grade report is one calendar month from the beginning of the semester following the filing of an erroneous grade. It is the responsibility of students to notify instructors of erroneous grades as soon as they have received final grade reports from the Office of the Registrar. Changes of grades other than the filing of grades for incompleted courses require the endorsement of the appropriate college dean. Grade changes may not be made on a student's permanent record card after the deadlines cited above unless such changes have been authorized by appropriate college deans prior to the expiration of the correction deadline. Accordingly, students who experience difficulty in contacting faculty members for the purpose of questioning assigned grades should consult the appropriate college dean prior to the expiration of the correction deadline.

WITHDRAWAL FROM COURSES

"W" and "X" are administrative symbols which indicate that a student has been authorized to withdraw from courses. These symbols, which are entered upon the student's permanent record card without prejudice, may be authorized only in accordance with established policies of the University and only upon student request.

Course Withdrawal Through the 40th Class Day

Students who desire to withdraw from courses with notations of "W" during the period from the 11th to the 40th class day of a semester must secure the signatures of advisors and course instructors on official course drop cards and must file these forms with the Office of the Registrar no later than the 40th class day. Students who do not complete the process of withdrawal by the 40th class day will not be assigned course notations of "W", will be subject to all instructor course requirements, and will receive final course grades. Since it may take several days to secure necessary faculty signatures, and since such unforeseen circumstances as late trains, automobile breakdowns, and faculty absences unexpectedly may extend the period during which a student has planned to complete the withdrawal process, a student who delays his or her course withdrawal until the end of the withdrawal period may discover that it is impossible to comply with the withdrawal deadline of the 40th class day.

When course withdrawal will result in a course load of less than 12 credits, authorization of the student's college dean and the University registrar is required.

Students who withdraw from all courses are required to withdraw from the University. Students receiving benefits from the Veterans Administration are not permitted to reduce their course loads below the full or part-time levels which they have reported to the Veterans Administration.

Course Withdrawal After the 40th Class Day

Course withdrawal after the 40th class day of a semester ordinarily requires withdrawal from the University but partial withdrawal may be authorized for extenuating circumstances of illness or critical personal emergency. A student who has remained in class after the 40th class day and has fallen behind in his or her course work for reasons of illness or critical personal emergency should file an academic petition, together with appropriate documentation, with the dean of the college in which he or she is enrolled. Following a review of the student's petition and verification of attached documentation*, the dean of the college may permit the student to withdraw from specified courses. The approved petition must be filed with the Office of the Registrar prior to the first day of final examinations. A student who fails to complete all course withdrawal procedures prior to the first day of the examination period will be denied permission to withdraw from a course with a notation of "X" and must be graded.

Students receiving benefits from the Veterans Administration are not permitted to reduce their course loads below the full or part-time levels which they have reported to the Veterans Administration.

*The assistance of the Dean of Students may be solicited in securing verification of medical and legal documents.

WITHDRAWAL FROM THE UNIVERSITY

All students who desire to withdraw from the University are required (1) to discharge all financial obligations to the University, (2) to return all University property, (3) to have a conference with the Dean of Students, and (4)

to file a written notification of withdrawal from the Office of the Registrar. Since the date of official withdrawal as recorded by the Office of the Registrar is one basis of any claim for tuition refund and may be of importance in determining subsequent legal or student insurance claims, students should process withdrawal papers in person prior to leaving the University. Students who absent themselves from the University without officially withdrawing will remain on class rosters until they officially withdraw from the University or until the end of the semester. Students who remain on class rosters after the 40th class day will be assigned final course grades. The date on which a withdrawal request is filed with the Office of the Registrar is the date on which withdrawal is academically effective and constitutes the basis for final course notations.

Students who are recipients of benefits from the Veterans Administration may not process withdrawals from the University which violate their declarations of classroom attendance. Recipients of veterans benefits are advised that they must receive course grades when their requests to withdraw from the University have been filed after deadlines of the Veterans Administration for processing changes of declared benefit status or when their dates of withdrawal will conflict with declarations of classroom attendance.

University Withdrawal Through the 40th Class Day

Students who register for courses and who withdraw from the University prior to the first day of classes of a semester are withdrawn without record. Students who register for courses and who withdraw from the University from the 1st to the 40th class day of a semester are withdrawn with course notations of "W".

University Withdrawal After the 40th Class Day

A student who withdraws from the University during the period from the 41st class day to the end of the semester must be graded by all course instructors unless authorized to withdraw for reasons of extended illness or extended personal emergency. A student who wishes to withdraw temporarily or permanently from the University after the 40th class day of a semester for such reasons must file an academic petition, together with appropriate documentation, with the dean of the college in which he or she is enrolled. Following a review of the academic petition and verification of attached documentation*, the dean of the college may permit the student to withdraw from all courses. The completed petition must be filed with the Office of the Registrar prior to the student's departure from the University.

*The assistance of the Dean of Students may be solicited in securing verification of medical and legal documents.

University Withdrawal After the End of the Semester

A student who has unofficially withdrawn from the University for reasons of extended illness or extended personal emergency and (for reasons acceptable to the dean of his or her college) has been unable to officially withdraw from the University before the end of the semester may petition to withdraw from all courses with symbols of "X". Such a student must file an academic petition, together with supporting documentation, no later than one calendar month from the beginning of the following semester. This petition must be filed with the Registrar, who will forward all materials to the appropriate college dean for a decision. Following a review of the academic petition and verification of attached documentation*, the dean shall forward his or her decision to the Registrar, who shall notify the student of the dean's decision. A student who has been the recipient of benefits of the Veterans Administration may petition to withdraw from the University after the end of the semester only when he or she has been provided with written authorization from the Veterans Administration.

*The assistance of the Dean of Students may be solicited in securing verification of medical and legal documents.

ADMINISTRATIVE DISMISSAL FROM THE UNIVERSITY

A student may be administratively dismissed from the University through cancellation of registration for due cause, through suspension or expulsion for academic dishonesty, and through disciplinary procedures for violations of good conduct. For information concerning disciplinary procedures which govern violations of campus conduct, cf. "Student Regulations" in this bulletin.

Non-Academic Dismissal

Administrative dismissal may be invoked when a student fails to comply, *after due notice*, with an administrative requirement of the University. Official notification of an administrative dismissal is noted on the permanent record card by the symbol "Y", which is entered for each course which has been carried by the dismissed student. Reinstatement of a student who has been administratively dismissed may be made only by application for readmission with the Office of Admissions and only when the condition which has necessitated administrative dismissal can be ameliorated to the satisfaction of University officials. Examples of some conditions which may justify administrative dismissal are as follows:

Forgery or fraudulent use of University records, documents, or forms;

Non-payment of tuition, board, room charges, student fees, library fines, overdue University loans, and other official University fiscal obligations;

Failure to comply with duly authorized administration order relating to the safety of persons or the protection of University property;

Failure to submit necessary health forms as required by University Health Services; and

Failure to withdraw from the University after certification of a physical health or mental health program of a hazardous nature.

Academic Suspension and Expulsion

Students who have evidenced academic dishonesty may be administratively suspended or expelled from the University in accordance with the following policies.

The following definitions are provided for the information of all students and constitute official notice of prohibited academic practice and behavior.

Cheating is defined as (a) misrepresenting academic work which has been done by another as one's own efforts—whether such misrepresentation has been accomplished with or without the permission of the other individual, (2) utilization of prohibited assistance (whether in the nature of a person or a resource) in the performance of assignments and examinations, (3) copying of another person's work or the giving or receiving of information or answers by any means of communication during an examination, (4) utilization of the services of a commercial term paper company, and (5) the unauthorized or fraudulent acquisition and/or use of another's academic property.

Plagiarism is defined as direct quotation or word-for-word copying of all or part of the work of another without identification or acknowledgement of the quoted work, (2) extensive use of acknowledged quotation from the work of others which is joined together by a few words or lines of one's own text, and (3) an abbreviated restatement of someone else's analysis or conclusion, however skillfully paraphrased, without acknowledgment that another person's text has been the basis for the recapitulation.

1. Obligations of Faculty Members

Although each student is responsible for complying with the above notice of prohibited practice and behavior, faculty members are responsible for publishing their special requirements for completing assignments and taking examinations. Such requirements must be explicitly made through the published statement of course requirements or through examination and assignment directions.

Preservation of the integrity of the academic process is an exercise of professional judgment and is both a faculty right and a faculty duty. Although such judgment is without defense if it is arbitrary and/or capricious in its particular application, the rendering of a professional judgment when charging or adjudicating an academic offense is not subject to the canons of evidence which are specified in courts of law. Hence the work of the student may not be expected to carry the same weight as that of a faculty member in such cases where the faculty and student disagree. At a minimum, however, the faculty member is expected to be honest and equitable and to inform a student who is charged with an academic offense of the particulars of such a charge and the penalties which will be recommended.

In assessing penalties for academic dishonesty or prohibited academic practice and behavior, faculty members and designated authorities of the appeal process should consider the nature of the offense, the question of premeditation, and any previous record of dishonesty or violation of prohibited practice and behavior. Neither the student nor the university can be served when the punishment is not proportionate to the offense.

2. Notification Requirements

No faculty member may reduce a grade (including the assignment of an "F") for either an entire course or for any portion thereof on the grounds of academic dishonesty and/or prohibited academic practice and behavior unless the faculty member provides the student with a written statement of charges, including specification of penalties which the faculty member will impose or seek to have imposed. Should the faculty member fail to allege against the student a charge of academic dishonesty and/or prohibited academic practice and behavior, no penalty may be imposed. Written notice may be provided through either an informal or formal notification procedure.

a. Informal Notification Procedure

In cases of observed cheating or observed violation of testing or classroom assignment requirements, the faculty member shall notify the student verbally prior to the end of the examination or class period and shall make an appropriate written comment on the student paper. In cases of reported cheating or violation of testing or classroom assignment requirements, detected plagiarism, or other cases in which the commission and detection of academic dishonesty are not coincident, the faculty member shall provide notification by making an appropriate comment on the paper in question.

The information notification procedure may not be used for offenses which are detected after the administration of the final course examination or (in the event that no final examination is administered) after the last class of a semester. Nor may the informal notification procedure be used if the faculty member wishes to impose penalties which range from course failure to suspension from the University.

b. *Formal Notification Procedure*

Formal notification of a charge of academic dishonesty or violation of prohibited academic practice and behavior shall be provided to the student on a special form which has been developed for this purpose, and a copy of such notification shall be forwarded to the department chairperson, the chairperson of the college academic standards committee, and the college dean.¹

Except as provided below for charges concerning final examinations, papers, or exercises, formal notification of a charge of academic dishonesty or violation of prohibited academic practice and behavior shall be made within three class days² of the time that the faculty member became aware of the student offense.

In the event that a formal charge of academic dishonesty or violation of prohibited academic practice and behavior is made concerning a final course examination, paper, or exercise, such charge shall be issued prior to the filing of the final course grade and either shall be given to the student in person or shall be mailed (return receipt requested) to the student at his or her official home address of record.³

¹The terms "department chairperson", "college dean", and "college academic standards committee" refer, respectively, to the designated officials and committee of the college in which the concerned course is offered.

²The term "class day" is defined as any day when classes and final examinations are scheduled. It also applies to days when University offices are open during the week which immediately precedes the first scheduled day of semester classes.

³All such notices are mailed by the Office of the Registrar.

3. *Penalties for Academic Dishonesty or Prohibited Academic Practice and Behavior*

Penalties for academic dishonesty or prohibited academic practice and behavior may range from failure for an examination or assignment through course failure and expulsion from the University. Penalties up to and including course failure may be imposed by faculty members. The penalty of suspension shall be imposed for a semester or academic year. The penalty of expulsion from the University shall be permanent. Either of these penalties may be recommended by the faculty member, or at any level of the appeal process, but may be imposed only by the college dean.

In the event that the dean of the college in which an academic offense has taken place shall approve or impose either a penalty of suspension or expulsion from the University upon a student who is matriculating for a degree in a college other than that in which the academic offense has taken place, the imposition of suspension or expulsion shall require the concurrence of the dean of the college in which the student is matriculating. If the deans do not concur, they shall arrive at a mutually agreeable penalty and such decision shall be final.

In those cases in which an allegation of academic dishonesty or prohibited academic practice and behavior is supported by the admission of the student, the assignment of a grade for the course or portion of the course and the question of an alternative assignment or substitute examination shall be at the discretion of the faculty member.

The final grade filed by a faculty member who has charged a student with an academic offense concerning an end-of-course examination, paper, or exercise shall be an "incomplete" with an end of course letter grade which shall be assigned in the event that the student makes no appeal or the charge is sustained through appeal and the penalty is reaffirmed. If the determination of penalty which is made at the last step of the appeal process as invoked is different from that which was initially made, the faculty member shall file a correction of final letter grade which is in compliance with this determination.

4. *Special Procedure for Penalties Relating to Professional Licensure and/or Certification*

The implications of academic dishonesty or violation of prohibited academic practice and behavior for ethical standards which are specified by law for professional licensure and/or certification are questions which properly reside with professional review bodies or department faculty. Hence the decisions concerning student continuance or discontinuance in a professional program shall not be made by individual faculty members or by designated authorities of the appeal process defined below. A decision of a professional review body or of a department faculty to drop a student from a professional program subsequent to the imposition of a penalty for academic dishonesty or violation of prohibited academic practice and behavior shall be final and shall not be appealed to the college dean.

5. *Procedures for Adjudicating Charges of Academic Dishonesty or Violation of Prohibited Academic Practice and Behavior*

a. *Informal Procedure of Notification and Discussion of Charges*

The informal procedure for written notification of academic dishonesty or violation of prohibited academic practice and behavior may be used when, in the judgment of the faculty member, the penalty invoked is limited to a lowering of the grade for the work in question and the work is personally returned to the student prior to the final examination period. Within three class days of notification, the student may request, and the faculty member shall arrange, a meeting to discuss the charge and the penalty specified or the student may file a formal appeal of the specified charge and/or penalty to the department chairperson.

The flexibility of an informal discussion tends to promote a more desirable resolution of differences than do formal procedures and hence is the recommended first step of any procedure for resolving issues of alleged academic dishonesty. The purpose of the informal meeting is to clarify possible misunderstandings between the student and the faculty member, to discuss the impact of the proposed penalty upon the student's final grade, and to pursue any question relative to the charges and penalties.

Neither the informal procedure of notification nor the informal discussion of charges requires notification of authorities which are specified by the formal appeal process and hence provides an opportunity for both the faculty member and the student to clearly understand the bases of disagreement before a formal statement of charges is filed with a third party. Within three class days of the informal discussion of charges, the student shall advise the faculty member that he or she accepts the charge and penalty specified or that he or she will file a formal appeal with the department chairperson. If the student does not initiate a formal appeal, the charge may not be challenged and the penalty invoked may not be appealed.

b. *Formal Procedure of Notification and Adjudication*

A formal procedure of adjudication must be initiated by the faculty member when a charge of academic dishonesty is made for work which is not personally returned to the student prior to the final examination period.

The faculty member must provide the student, the department chairperson, the chairperson of the college academic standards committee, and the college dean with copies of formal charges within one class day following student notification of intent to appeal.

(1) *Formal Hearing with the Department Chairperson*

Within seven class days of receipt of a formal notification of academic dishonesty, the department chairperson shall hold a meeting with the faculty member and the student to discuss the charges and/or penalties. At the end of the meeting, the department chairperson shall notify the parties of his or her judgment and recommendation of penalties. If there is no further appeal, the department chairperson's decision shall be final.

(2) *Formal Hearing with College Academic Standards Committee*

Either the student or the faculty member may appeal the chairperson's decision to the college academic standards committee. This appeal must be made within three class days of the chairperson's decision. The academic standards committee shall meet with the department chairperson, the faculty member, and the student within seven class days of the requested appeal. Within three class days, the committee shall notify the concerned parties of its decision. If there is no further appeal, the committee's decision shall be final.

(3) *Formal Hearings with the College Dean*

Either the student or the faculty member may appeal the decision of the college academic standards committee to the college dean. This appeal must be made within three class days of the committee's decision. The college dean shall meet with the chairperson of the college academic standards committee, the department chairperson, the faculty member, and the student within seven class days of the requested appeal. Within three class days, the college dean shall notify the concerned parties of his or her decision. The decision of the college dean shall be final and hence may not be appealed.

6. *Right of Student Counsel for Formal Hearings*

A student who has been formally charged with an academic offense may request representation from the counselling staff, the Office of the Dean of Students, or the full-time faculty to provide aid and assistance at any stage of the formal hearings. Such counsel shall be provided with copies of documents which have been forwarded to hearing authorities and he or she shall be present for all formal hearings.

7. *Special Provisions*

a. *Student Status During Period of Appeal Process*

While an appeal process concerning an academic offense remains unresolved, the charge shall not prejudice the right of a student who has not otherwise been suspended for unsatisfactory academic performance or student misconduct from continuing his or her course of study at the University.

The timetables which have been specified above for the conduct of appeal processes have been developed to insure the speedy resolution of both the charges and the student's University status. In the event that resolution of a charge of academic dishonesty cannot be made prior to the beginning of next semester and a charge of academic dishonesty is subsequently sustained and the penalty imposed either requires or results in suspension, the student shall be dropped from the University immediately and accordingly may not be permitted to complete courses for which he or she may have registered.

b. *Failure to Attend Scheduled Hearings*

A party of an appeal hearing who is unable to attend his or her hearing as scheduled must notify the appeal authority as soon as possible, preferably one day in advance. An individual may be excused from attendance and may be granted a second hearing for good and sufficient reason acceptable to the appeal authority.

Except that the penalty of suspension from the University shall require the concurrence of the college dean, an appeal authority at any level may resolve a charge of academic dishonesty and/or may impose a penalty without recourse to subsequent hearings, if, without prior notice, the appealing party has failed to appear as scheduled for an appeal hearing.

A party of an appeal hearing who was unable to provide prior notice of his or her inability to attend and appeal hearing as scheduled may submit an academic petition to the college dean requesting a rehearing before the appropriate authority. The college dean may grant a rehearing for reasons of serious illness, accident, critical personal or family emergency, or other such acceptable reasons, and his or her decision concerning a rehearing shall be final.

ACADEMIC STANDING

Academic standing and eligibility for a degree are determined by the quality of the student's course work.

Determination of Academic Standing

To ascertain the student's academic standing, the University uses a point system, each qualitative grade having an equivalent numerical value. A grade of "A" has a value of 4.00, a grade of "AB" a value of 3.50, a grade of "B" a value of 3.00, a grade of "BC" a value of 2.50, a grade of "C" a value of 2.00, a grade of "CD" a value of 1.50, a grade of "D" a value of 1.00, and a grade of "F" a value of 0. Quality points are computed by multiplying the course credit by the numerical value of a qualitative grade assigned. For instance, a 3 credit course completed with a grade of "BC" would carry 7.50 quality points (3×2.50). The grade-point average is obtained by dividing the

total number of quality points earned by the total number of credits completed and graded with those qualitative grades which are cited above.

Each student is subject to the following grade-point requirements# for the specified numbers of attempted course hours:

Course Hours Attempted*	Grade-Point Averages Satisfactory Standing†	Grade-Point Averages Academic Warning†	Grade-Point Averages Suspension Category
12-30	1.500	1.400-1.499	1.399 or below
31-45	1.600	1.500-1.599	1.499 or below
46-60	1.700	1.600-1.699	1.599 or below
61-75	1.800	1.700-1.799	1.699 or below
76-90	1.900	1.800-1.899	1.799 or below
91-graduation	2.000	1.900-1.999	1.899 or below

#The cited grade-point averages are *minimum* University requirements. Individual colleges or departments may establish higher requirements.

*Included in Course Hours Attempted are all course credits which have been granted (including credits awarded through transfer and challenge by examination, course credits which have been awarded with qualitative letter grades, and credits attempted with notation of "Inc" or with nonqualitative grades of "P" and "S") and all hours of course work which have been failed with the qualitative letter grade of "F". Courses which have been failed and which carry the nonqualitative symbols "U" and "NC" are not included in the computation of Course Hours Attempted.

+ Specified Grade-Point Averages are computed solely on the basis of those courses attempted at the University of Lowell (or through University auspices within policies governing authorized off campus study) which have been qualitatively evaluated with the following letter grades: "A", "AB", "B", "BC", "C", "CD", "D", and "F".

Review of Academic Records

For the purpose of determining the academic standing of students, the Office of the Registrar evaluates all student records at the end of each semester and makes appropriate notation of unsatisfactory academic status ("Academic Warning" or "Suspension Category") on student permanent record cards. Freshmen students are initially evaluated for retention purposes at the end of the semester in which they have attempted their first 12 credits at the University. Transfer students are initially evaluated for retention purposes at the end of the semester in which they have attempted their first 18 credits at the University. Entering freshmen and transfer students who are permitted to initiate their University studies with summer school day courses should note that credits attempted in University summer sessions are included in calculations for the fall semester. Entering students who have initiated their University studies in authorized summer school courses are not permitted to invoke the regulation concerning course repetition for the purpose of grade substitution prior to the initial evaluation of their records for retention purposes. The records of matriculated students in the Second Chance Program are initially evaluated for retention purposes at the end of the semester in which they have attempted their first 12 credits of matriculated study. Subsequent to initial evaluations for retention purposes, the records of all full-time students, (including probationary students) must register for courses which comply with prescribed courses of study and must comply with the policies concerning semester course loads and reduced load status.

Academic Warning

A student whose cumulative grade-point average falls below the minimum University requirement for course hours completed by no more than 0.10 is immediately placed on academic warning. A full-time student who has been placed on academic warning and who has not attained satisfactory standing by the end of the following full-time semester is suspended from the University. A matriculated student in the Second Chance Program for Adults who has been placed on academic warning is required to achieve satisfactory standing by the end of the semester in which the next 15 credits have been attempted following his or her notification of academic warning. Students who have been placed on warning that their academic achievement is deficient should consider the desirability of declaring another major or of transferring to another college within the University. *Students on academic warning are prohibited from holding student offices and from representing the University in athletic or other activities.*

Academic Suspension

A full-time student, reduced-load student, or matriculating student in the Second Chance Program for Adults whose cumulative grade-point average at the end of any semester falls below the minimum University require-

ment for course hours completed by more than 0.10 is immediately suspended. A student who has been suspended is prohibited from enrolling in any program of the University, including credit courses of continuing education and summer sessions of the University. University credits earned in violation of this prohibition will not be honored if and when the student seeks probationary readmission to the University.

Academic Probation

A student who has been suspended from the University is entitled to apply to the Office of Admissions for readmission as a probationary student in accordance with procedures enumerated under the admission policy heading "Probationary Readmission." Students who are readmitted on probation will receive a letter from the academic standards committee which will specify the conditions of their probation, their probationary courses (not less than 12 credits for other than matriculated Second Chance students) and the semester average which they must achieve during their probationary semester in order to achieve satisfactory academic standing. *Probationary students are prohibited from holding student offices and from representing the University in athletic or other activities.*

A student who achieves the required semester average during his or her probation is automatically reinstated as a student in satisfactory academic standing. A student whose semester average falls below the required semester average by no more than 0.10 may be granted an extension of the probationary period for one additional semester. Such extension of probation, if granted, will be made by the appropriate academic standards committee during the period between semesters. Students who are granted such extensions will be notified in writing prior to the beginning of classes for the following semester that they have been granted an additional semester to achieve satisfactory academic standing. Students who fail to achieve satisfactory academic standing and are not granted extensions of their probations by the appropriate academic standards committees and students who are granted such extensions and fail to achieve satisfactory academic standing are permanently dismissed from the University and are subsequently barred from attending both day and evening courses.

Students who are readmitted on probation may not invoke University regulations which govern course repetition for the purpose of deleting "F" grades from cumulative averages.* Nor may they withdraw from any course unless they withdraw from the University with permission of the college dean for reasons of emergency or for medical reasons. A probationary student who withdraws from any course cannot by definition satisfy the conditions of his or her probation and will be permanently dismissed from the University at the end of the current semester of enrollment.

Probationary students who receive course evaluations of "I" (incomplete) and who fail to make-up their work prior to the beginning of the next semester are advised that they may not qualify for extension of their probation, may not register for nor attend University courses (including continuing education courses), and may not receive authorization to pursue off-campus studies until such time as a final determination of their status has been made. Probationary students who have received permission of a college dean to extend their make-up period should understand that such extension does not waive the requirement for a final determination of academic standing which is based upon grades for all probationary courses.

Students who have enrolled in Summer School and/or Continuing Education courses subsequent to notification by the Office of the Registrar that they were suspended from the University for unsatisfactory academic standing are in defiance of University regulations. Grades received by such students will not be credited to University baccalaureate programs whether or not they are reinstated as probationary students or achieve satisfactory academic standing after reinstatement.

*Following the attainment of satisfactory academic standing and removal from probation, a student who has completed probationary requirements in the college from which he or she was previously suspended and who has failed a course during the two semesters preceding suspension and has repeated and passed such a course during his or her probationary period may retroactively invoke the provision which permits deletion of the course failure from the cumulative grade-point average.

REGISTRATION AND COURSE ENROLLMENT POLICIES

All students are required to register for courses during periods which are officially designated for registration and preregistration unless they have been authorized to make other arrangements by the dean of the college in which they are matriculated. Non-matriculated students are permitted to enroll for course loads only as specified by

their conditions of admission. Except for part-time students in the Second Chance Program, all matriculated students (including probationary students) must register for courses which comply with prescribed courses of study and must comply with the following policies concerning semester course loads and reduced load status.

Semester Registration

Students are required to register in person during the designated preregistration and registration periods. Students have complied with the preregistration requirement when they have had a schedule of lecture, recitation, and laboratory work approved by their advisors and have filled in and processed the forms provided by the Registrar's Office. They have satisfied the registration requirement when they have paid the required tuition and fees and have complied with the course drop and add process. Endorsements of instructors and advisors are required for each change of enrollment card which is filed. Students who preregister for courses for which they subsequently fail to satisfy prerequisites must initiate changes of enrollment during the drop-add period unless they have the permission of instructors to remain registered in these courses. *Students are not enrolled in classes for which they are not properly registered.*

The Office of the Registrar mails copies of individual semester schedules to students through their University mail boxes. Students are advised that such mailing constitutes official notification from the University concerning each individual's record of course registrations. Students who believe that errors have been made in their registrations should consult with the Office of the Registrar prior to the deadline for adding courses. *Students who do not check their mail boxes and accordingly fail to correct scheduling errors by established deadlines may not expect to have University regulations waived for their benefit.*

Course Changes

Adds

Students who wish to ADD a course during the first 10 days of classes must do so by filling out a Change of Registration Form "adding" the class. Student must obtain appropriate signatures and return form to the Registrar's Office. Any course which is added during the first 10 days of classes is subject to a fee. A fee is charged unless a waiver is obtained from the Dean of the College in which the student is enrolled.

Section Changes

Students who find it necessary to change a section within the same course because of time conflicts must file a Change of Registration Form with the Registrar's Office within the first 10 days of classes. Signatures of both instructors are necessary. A fee is charged unless a waiver is obtained from the Dean of the College in which the student is enrolled.

Drops

Students who wish to drop* a course must do so by filling out a Change of Registration Form "dropping" the class, obtain proper signatures, and return the form to the Registrar's Office. Courses that are dropped are subject to a fee unless a waiver is obtained from the Dean of the College in which the student is enrolled. There are only two cases for which a Drop is not necessary:

1. If the course is cancelled by the University.
2. Courses (or sections) that have 0.0 credits and will not appear as part of the final transcript.

* Courses dropped during the first 10 days of classes will not show on final record. Courses dropped from the 11th to the 40th day of class will be issued a grade of "W" and will appear on the final record.

Courses Cancelled By the University

Students registered in a cancelled section will not have to drop this course as this will be done automatically at the end of the semester. If it is necessary to replace the cancelled course, there are two options available.

1. If substituting a different course, fill out a Change of Registration Form "adding" the replacement only—DO NOT DROP THE CANCELLED SECTION. Student must obtain proper signatures. Submit form to the Dean of the College in which a student is enrolled for a fee waiver before returning it to the Registrar's Office.
2. To enter a different section of the same course a Change of Registration Form should be filled out to "section change" from the cancelled section to an existing section. Obtain signature of the instructor in the new existing section only. Submit form to the Dean of the College in which the student is enrolled for a fee waiver before returning it to the Registrar's Office.

Waiver of Fees

Waiver of fees for a course change is granted when the change is necessitated by the cancellation of a class by the University. *A waiver of fee is NOT granted when the change is initiated by the student for any reason, including the unavailability of courses at registration.* A Dean of a College may grant a waiver for special circumstances for which, in the dean's judgment, sufficient reason exists.

Semester Course Loads

The typical course load expectation for full-time students is 15 credits. Professional curricula may specify credits in excess of this number, in which case such specifications are regarded as regular course loads.

Maximum Credit Loads

Students may enroll for course loads in excess of 15 credits but are advised that course loads in excess of the number of credits specified by recommended courses of study may not be in their academic interests when their grade-point averages are less than 3.00. Unless specified as part of an established course of study, course loads in excess of 15 credits are recommended for enrichment purposes only and should be taken as pass courses. In any event, a student is prohibited from registering for course loads in excess of 18 credits unless such loads are required by established University curricula or unless special permission has been granted by the dean of the college in which the student has established matriculation. Students who are enrolled in curricula which do not require a semester course load in excess of 18 credits and who wish to obtain permission to carry such an overload must file an academic petition with the dean of the college in which they have established matriculation. Students who register for course loads in excess of 18 credits (including continuing-education courses) without the prior authorization of the dean of the college in which they have established matriculation will not receive credit for more than 18 credits per semester and the college dean shall determine which course(s) shall receive the administrative symbol(s) of "Y." Permission to carry course loads in excess of stated maxima will be denied when resources of a college or program render it necessary to establish limitations on course enrollments.

Minimum Credit Loads

Matriculating students are classified as full time when they carry a course credit load in University day programs which is specified by their curricula. Full-time students are required to register for a minimum of 12 credits of day courses each semester and, unless subsequently granted reduced load status, to remain registered for 12 credits of day courses at all times.

Reduced Load Status

Upon the written recommendation of college deans, full-time students may petition for exemption from the minimum course load requirement for reasons involving health or critical personal and academic problems. Such petition may be filed up to the 40th class day of the semester but cannot be made more than twice during a student's undergraduate career. Permission to carry a reduced load does not waive the requirement for completing degree requirements within ten full-time semesters unless subsequent permission to extend the undergraduate period of study is granted by the dean of the college in which the student is matriculated.

Students who have been granted reduced load status are subject to all fees and academic regulations which are in effect for full-time students. Reduced load students are advised that they are not eligible for tuition refunds, that their financial aid eligibility may be jeopardized, that they may be ineligible to participate in varsity athletics, and that they must maintain satisfactory academic standing at the end of the semester during which a reduced load is authorized.

REPEATED COURSEWORK

General Policies

Course repetition is permitted only in accordance with the policies cited below, the provisions of which are applicable only to courses taken at the University of Lowell and consequently may not be extended to off-campus courses. A course substitution is not permitted under policies governing repeated courses unless a course has been authorized as a suitable substitute by the chairperson of the department which offered the course which is to be repeated.

Probationary students may not invoke the grade-substitution rule during their periods of probation. (Cf. below for Grade Substitution Rule.) However, if they have repeated courses while on probation, they may invoke this rule retroactively at the beginning of the semester which immediately follows their removal from probation.

Grade Substitution Rule

Students who have entered the University as freshmen or transferred to the University with less than 60 semester credits are permitted a maximum of 10 semester credits of course repetitions for the purpose of substituting

grades for previously completed courses in the computation of their cumulative grade-point averages. (Transfer students who have entered the University with 60 or more semester credits are permitted a maximum of 7 semester credits of course repetitions for this purpose). The number of actual course repetitions which are permitted for any student depends upon the number of credits which are allocated to those courses which he or she wishes to repeat. For instance, a student who has entered the University as a freshman may repeat a 3 credit course three times or a 4 credit course two times. However, such a student may not repeat both a 3 credit and a 4 credit course two times since such repetitions exceed the maximum number of semester credits which are permitted under the grade substitution rule.

Administrative Requirements

When students register for courses which they wish to repeat, they must notify the Office of the Registrar at the time of registration for the fall or spring semester, or at the time of registration for University summer sessions. Students who wish to repeat courses which they have previously passed must file an approved academic petition at this time. Such students are advised that permission to repeat courses may be denied when resources of a college render it necessary to establish limitations upon course enrollments.

Deadlines

Students in satisfactory academic standing and students on academic warning may repeat courses within two semesters of their previous course completions or during the semester in which the courses are next offered—whichever period is later. Probationary students who have satisfied their conditions of probation may repeat those courses which they completed during the two semesters immediately preceding their suspensions. These courses must be repeated within two semesters of probation or during the semester in which they are next offered—whichever period is later.

Repetition of Passed Courses

Except for courses of a professional nature which regulations of a college may designate as being non-repeatable, students may repeat previously passed courses within the provisions of the grade substitution rule cited above. When a previously passed course has been repeated within the provisions of this regulation, the cumulative grade-point average is appropriately corrected for the semester in which the course is repeated. *If the grade for the repeated course is lower than the original grade in the course, both grades will be counted in the student's cumulative average. Credit is never granted twice for a course which has been taken & passed & subsequently taken again and passed for the second time.*

Repetition of Failed Courses

Except for courses of a professional nature which regulations of a college may designate as being non-repeatable, students must repeat and pass all required courses which they have failed. Courses in which "F" grades have been received must be repeated and passed before students may take courses for which those failed are prerequisites. A course which is failed but is not required for a student's program need not be repeated, but other course work must be taken when a student's total degree program will fall short of the specified credit hours for degree requirements. Unless a failed course is repeated within the provisions of the grade substitution rule, cited above, both the original failing grade and the repeated course grade are counted in computing grade-point averages. Although the provisions of the grade substitution rule and the requirements for maintaining satisfactory academic standing may indirectly limit the number of failed courses which a student may repeat, no formal limitation is placed upon the number of failed courses which may be repeated.

Repetition of Transferred Courses

When competence is demonstrably inadequate, a student who has been granted transfer credit (and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite) may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred.

Permission to repeat a transferred course is granted by filing an academic petition form with the dean of the college. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

UNIVERSITY OF LOWELL CONTINUING EDUCATION & SUMMER SCHOOL COURSES

Subject to University residency requirements and college regulations,* the following categories of day students may be permitted to register for continuing-education and summer-school courses at the University of Lowell and to have such courses credited to baccalaureate day programs: (1) individuals who have been admitted to day colleges for full-time baccalaureate study, (2) individuals in satisfactory academic standing who are currently matriculating in day colleges of the University, and (3) previously matriculated students in day colleges who withdrew from the University while in satisfactory academic standing, who have been absent from the University for periods of not more than two semesters, and who have been readmitted to programs in which they were previously enrolled.

Individuals are warned that departments reserve the right to deny baccalaureate credit for University of Lowell continuing-education and summer-school courses which have been taken in violation of University residency requirements, curriculum requirements of their baccalaureate day programs, and/or special college regulations. Accordingly, individuals are advised to consult appropriate sections of this publication prior to enrolling in continuing-education and summer-school courses of the University in order to avoid subsequent denial of course credit during the period when programs of study are reviewed for the purpose of determining student satisfaction of degree requirements. Students who have been suspended or dismissed from day programs of the University are prohibited from enrolling in any program of the University. Students who combine University day courses with continuing-education courses during the regular academic year are subject to all restrictions concerning semester course loads. (Cf. "Registration and Course Enrollment Policies.")

*Special authorization is required by the College of Management Science for continuing education courses in areas of accounting, economics, and management.

OFF-CAMPUS STUDY

Individuals who have been admitted to day colleges for baccalaureate studies and who are enrolled currently in such colleges of the University (or who have been so enrolled within the previous two semesters and accordingly are subject to curriculum requirements in effect during the period of their previous enrollment) may be permitted to apply off-campus courses to their degree programs when they comply with established procedures. Off-campus courses may be taken in accredited institutions only and ordinarily should be taken at baccalaureate colleges or universities. Permission to pursue off-campus courses in accredited associate degree institutions may be granted only for courses which are to be presented for lower-division requirements of University of Lowell curricula. All off-campus courses must be taken under the regular grading system and may not be taken on a pass-no record basis.

Full University Recognition

Courses which are taken off campus may be treated as courses completed at the University if courses have been approved in advance and have been completed within course evaluation systems which are comparable to those letter grades of the University which carry quality-point designations. In order to achieve full recognition of such off-campus courses, a student must file a declaration of intent (together with appropriate endorsements by the student's faculty advisor, the chairperson of the major department, and chairpersons of departments offering those courses for which the contemplated courses are to be offered as substitutes) with the Office of the University Registrar prior to the initiation of off-campus courses. A separate declaration must be filed for each course to be taken. Upon receipt of an official transcript of record, the Office of the University Registrar will record the full report concerning all authorized courses (including courses which have been failed) upon the student's permanent record card and will compute all grades for off-campus courses into the student's cumulative grade-point average. It is the responsibility of the student to arrange with the office of the off-campus registrar for the forwarding of his or her official transcript to the University of Lowell prior to the end of his or her off-campus courses and to confirm the receipt of such transcript by the Office of the Registrar of the University of Lowell.

Transfer Recognition

Courses which have been completed off campus without the prior approval of faculty and/or without prenotification of the Office of the University of Lowell Registrar subsequently may be recognized as transferred courses without quality-point designations if they have been completed with grades of "C" (2.0 on a 4.0 scale) or better. Students wishing to receive recognition of such completed courses must petition the chairperson of their major department and the chairperson of the department offering those courses for which the completed off-campus courses are offered as substitutes and must file an approved academic petition with the Office of the Registrar *prior to the end of the semester which follows their completion of the off-campus courses.*

University Restrictions Concerning Off-Campus Study

Freshmen are not permitted to pursue off-campus courses until they have attempted 12 credits and an initial evaluation of their academic progress at the University has been made. Students who have transferred to the University with 60 or more semester credits, who have transferred with an associate degree, or who have been admitted from another institution with a baccalaureate degree to pursue a second bachelor's degree are not permitted to pursue off-campus studies. Students who combine University courses with off-campus courses during the regular academic year are subject to all restrictions concerning semester course loads.

Full-Time Off-Campus Study (Year Abroad and Visiting Student Programs)

Off-campus courses may be authorized on a full-time basis for those students who have completed (or who will complete prior to graduation) three years of full-time study at Lowell (earning not less than 90 semester credits) and who wish to pursue a year abroad or who wish to complete a year as visiting students at another baccalaureate institution while completing a Lowell degree. To receive authorization for such full-time study off-campus, students must comply with the procedures described above under the subheading "Full University Recognition." Since some colleges of the University do not permit full-time off-campus study, students should ascertain the policy of their college before pursuing arrangements with other institutions. Students who wish to pursue full-time off-campus studies are advised that they must satisfy residency regulations concerning courses in the major field. (Cf. "General Degree Requirements: Residency Requirements.")

SPECIAL MATRICULATION STATUS

Individuals who have qualified for part-time matriculated studies in the Second Chance Program for Adults and candidates for baccalaureate degrees in day colleges having less than 12 credits to complete who have been granted permission to carry part-time programs are classified as special matriculating students. Students who have less than 12 degree credits to complete may not petition for special matriculation status if they have previously carried reduced course loads for two semesters, and they may not be granted such status for more than two semesters. Special matriculating students pay limited fees and qualify for part-time tuition rates.

CALENDAR DEADLINES FOR CHANGES OF COURSE ENROLLMENT STATUS

The last day for students to add a course, to change sections within a course, and to change enrollment status from audit to credit or from credit to audit and from pass-no credit to letter grade or from letter grade to pass-no credit is the 10th class day of the semester. The last day for dropping a course without penalty (with a course notation of "W") is the 40th class day of the semester.

Students must file all change of status forms in the office of the University Registrar by the published calendar deadlines.

ADVISORY SYSTEM

Academic advising is performed by full-time faculty members. Students who have been accepted by departments for academic or professional majors receive their academic advising from a member of their major department or, in the case of students pursuing interdisciplinary majors, from members of an appropriate interdepartmental committee. Students who have not made declarations of their major fields are assigned faculty advisors from within the college in which they are enrolled. Entering students are advised during the period of initial registration by a cadre of faculty advisors and are subsequently assigned advisors on the basis of their declarations of major subject. If an advisor has not been assigned by the beginning of the advisory period of the student's second registration, the student should immediately reveal this fact to the dean of the college in which he or she is enrolled.

The faculty advisor assists the student in developing a program of courses prior to semester registration and in formulating a program of studies leading to a degree and generally provides whatever guidance and assistance a student may require in making appropriate academic decisions throughout his or her period of baccalaureate studies. *However, each student is personally responsible for complying with all rules and regulations of the University and is solely responsible for completing all degree requirements.*

The advisor maintains records showing the program of study for each of his or her assigned students, including subjects taken, grades received, and changes of contemplated programs. For the purpose of providing appropriate academic advising, each faculty member is available for consultation throughout the semester. Faculty members maintain three office hours per week on three different days during periods in which classes are scheduled and maintain a minimum of five office hours per week in accordance with University requirements during periods of student advisement for course registration. Schedules of faculty office hours are published by departments for their members and the schedule of faculty office hours for each faculty member is posted in such a manner as may be observed easily by students.

COURSE REQUIREMENTS

Within those policies which are listed below, faculty members are permitted to establish their examination and course requirements.

Course Examination Policies

Final examinations are required for all undergraduate courses of the University, unless exemptions have been granted by the department chairperson and the dean of the college. Exemption requests must be made by the end of the first month of the semester. Final examinations may not be given at a place or time other than those which have been specified by the Registrar. There shall be no final examinations other than those administered during the final examination period. No hour examination shall be administered during the last five academic days of the semester unless exemption has been allowed by the college dean. Final take-home examinations, may be submitted to instructors during the final examination period only. It is the responsibility of the instructor to notify each student concerning the time and place for submitting take-home examinations.

Instructor Course Requirements

Courses requirements must be provided in writing to all class monitors and to the department chairperson by the end of the first full week of classes. This statement must include a specification of the number and types of course evaluations to be employed throughout the semester (including approximate date and nature of the first evaluation), special requirements for completing assignments and taking examinations, and a definition of course attendance policy. By the end of the seventh week of classes, each faculty member and course coordinator must provide the department chairperson with the date, time, and nature of the first evaluation in the course.

Normally, a minimum of three evaluations of student progress (written or oral examination, written reports, recitations, laboratory techniques and reports, jury or performance evaluations) should be made in each course, at least one evaluation being required during each half semester. Upon the request of a student, an instructor is required to provide a statement of the student's course progress. Prior to the last date for withdrawing from courses, students who are in danger of receiving "D" or "F" grades either shall be so notified by the instructor or shall be in possession of such course evaluations as will permit such students to reasonably infer their course progress and academic jeopardy.

ATTENDANCE POLICIES

Although the University does not require class attendance as a matter of institutional policy, course instructors have the option of establishing required attendance in their courses and of specifying penalties for student violations of such attendance requirements. Colleges also have this option and sometimes have adopted attendance policies for introductory courses and specialized learning situations.

Instructor Attendance Policies

At the beginning of each course, the instructor will inform students of any specific attendance regulations which apply.

Attendance Requirements of the Veterans Administration

In compliance with the requirements of the Veterans Administration, all recipients of Veterans benefits, including eligible children of veterans, must certify their attendance at the University under penalty of perjury by the following procedures:

On the first Monday of each month, or on the following day if Monday is a holiday, each recipient of VA benefits is required to register his or her attendance at the office of the dean of his or her college. This procedure is also repeated on the third Monday, or on the following day if Monday is a holiday. All changes in status of the VA recipient also must be reported.

Failure to register attendance will be reported immediately by the College Dean to the Registrar, who will attempt to contact the student personally. If no satisfactory response is elicited for failure to register within one week of the reporting date, or if the Registrar is unable to reach the student at his or her official residence, the Registrar will inform the Office of the Veterans Administration that the University is unable to verify this student's attendance.

COURSE DESCRIPTIONS

Each course offering is designated by a two-digit prefix and a three-digit course number. The two digit college prefix identifies a college department and/or special subject area. In some cases the prefix also identifies laboratory or lecture courses and courses which are primarily for majors and minors. The three-digit course number identifies the course level.

Course Prefixes

Each college department and/or special subject area has been assigned an identifying number within the numerical ranges specified below.

Aerospace Studies	29	Liberal Arts	40-59
Education	01-09	Management Science	60-69
Engineering	10-28	Music	70-79
Health Professions	30-39	Pure & Applied Sciences	80-99

Course Numbers

Courses numbered 001-099 are prefreshman and special undergraduate courses and do not carry baccalaureate degree credit. Those numbered 100-299 are lower-division undergraduate courses and those numbered 300-499 are upper-division undergraduate courses. The 400 level courses are generally limited to juniors and seniors majoring in a field but are open, with permission, to other advanced undergraduates and to graduate students. Directed studies courses and practicum experience courses are generally limited by departmental policy to students majoring in the area in which such courses are offered. Courses numbered 500-599 are graduate courses which are open to upper-division undergraduates with the consent of instructors and chairpersons. Courses numbered 600-699 are graduate courses which are open only to graduate students. Courses numbered 700-799 designate graduate research projects and graduate theses.

Course Restrictions

Special course prerequisites, corequisites, and enrollment restrictions are indicated at the end of the course description. A course which is listed as a prerequisite must have been completed and passed prior to taking the course for which the prerequisite is specified. An exception to this limitation may be granted by the designated instructor only. A course which is listed as a corequisite must be taken during the same semester as the course for which the corequisite is specified. Courses which carry such notations as "open for majors only" and "sophomore status required" are restricted to the specified students. Courses which carry the notation "permission of instructor" require instructor approval prior to filing enrollment cards with the Office of Registrar. Courses at the 100-300 levels which do not carry prerequisite, corequisite and enrollment restrictions are open for election by all students unless general restrictions have been listed under the department or course area heading.

AEROSPACE STUDIES (Air Force ROTC)

University Policies Concerning Aerospace Courses

Both GMC (AS 100 and AS 200) and POC (AS 300 and AS 400) courses in Aerospace Studies may be used as undesignated or unrestricted elective courses in a student's baccalaureate program. Grades for all AFROTC courses are applicable to the determination of grade-point averages. Students should consult the regulations of the college in which they are matriculating concerning the number of AFROTC courses which may be included as part of their programs of study. In the event that such elective courses are insufficient to accommodate all the AFROTC courses, students wishing to pursue the AFROTC program will be required to fulfill program requirements on an overload basis. Consequently, AFROTC credit toward graduation requirements will vary from six (minimum to meet Air Force ROTC/U Lowell contract requirements) to sixteen credits depending on the student's particular college and degree program. Some colleges allow AFROTC courses to be substituted for technical or general electives.

The Air Force ROTC Program

The program is designed to qualify for commissions those men and women who desire to serve in the United States Air Force and to provide an education which will develop skills and attitudes of vital importance to professional Air Force officers. The Air Force ROTC program is divided into two phases: (1) the General Military Course (GMC), and (2) the Professional Officer Course (POC)

Students may elect to enroll in the four-year AFROTC program or the two-year AFROTC program. Students electing the four-year program will take the General Military Course during their freshman and sophomore years. The GMC consists of one hour of class and one hour of Leadership Laboratory per week. Students in the four-year program attend four weeks of Field Training during the summer between their sophomore and junior years. As members of the program, they are eligible to compete for AFROTC scholarships. For acceptance into the Professional Officer Course, students enrolled in the four-year program must pass a physical examination, an officer qualification test, and possess an acceptable academic record. The POC consists of three hours of class and one hour of Leadership Laboratory per week.

To qualify for enrollment in the two-year program, students must have two academic years remaining at either the graduate or undergraduate level or combination of these levels. They must also meet certain physical standards, pass an officer qualification test, and possess an acceptable academic record. They must also successfully complete a six-week Field Training course before they can be accepted into the POC.

Uniforms, equipment and textbooks which are required for AFROTC will be supplied. Students in the POC receive a monthly subsistence allowance of \$100.00. Competitive scholarships are available for a limited number of cadets in the program. Students who successfully complete the POC are commissioned as Second Lieutenants in the United States Air Force Reserve and serve on active duty in the Air Force in a specialty which is closely related to their academic training and is consistent with needs of the Air Force.

All GMC scholarship cadets must satisfactorily complete a course in English composition within two years of the scholarship activation. In addition, all scholarship cadets must satisfactorily complete one term of a major Indo-European or Asian language prior to commissioning. All cadets, both scholarship and non-scholarship, must complete a course in mathematical reasoning prior to commissioning.

Field Training

AFROTC Field Training is offered during the summer months at selected Air Force bases throughout the United States. Students in the four-year program participate in four weeks of Field Training, usually between their sophomore and junior years. Students applying for entry into the two-year program must successfully complete six weeks of Field Training prior to enrollment in the Professional Officer Course.

The major areas of study in the four-week Field Training program include junior officer training, aircraft and aircrew orientation, career orientation, survival training, base functions and Air Force environment, and physical training.

The major areas of study included in the six-week Field Training program are essentially the same as those conducted at four-week Field Training and in the General Military Course including Leadership Laboratory.

AFROTC students who successfully complete either the four or six week Field Training program will have their university physical activities requirement waived.

Leadership Laboratory

Leadership Laboratory is taken an average of one hour per week throughout the student's period of enrollment in AFROTC: 60 hours in the General Military Course and 60 hours in the Professional Officer Course. Two-year program students participate in the latter only. Instruction is conducted within the framework of an organized cadet corps with a progression of experiences designed to develop each student's leadership potential. Leadership Laboratory involves a study of Air Force customs and courtesies; drill and ceremonies; career opportunities in the Air Force; and the life and work of an Air Force junior officer. Students develop their leadership potential in a practical, supervised laboratory, which typically includes field trips to Air Force installations throughout the United States.

DEPARTMENT OF AEROSPACE STUDIES (Course Prefix: 29)

Lt Col Ronald E. Dullen, Chairperson

Professor: Ronald E. Dullen

Assistant Professors: Edward R. Ophof, Paul J. Schrag, Peter D. Varhol

The Department of Aerospace Studies is a unit of the Office of Academic Affairs and conducts the Air Force ROTC program. All ROTC courses may be taken by any university student without actually joining the AFROTC program. Call (617) 459-9301 or stop by Southwick, Room 328, for additional information.

29-101 THE AIR FORCE TODAY—PART I

I(1,0)1

This course deals with the Air Force in the contemporary world through a study of the total force structure, strategic offensive and defensive forces, general purpose forces, and aerospace support forces. Capt Ophof.

29-101 THE AIR FORCE TODAY—PART II

II(1,0)1

Completion of the material described in 29-101. Capt Ophof.

29-201 THE DEVELOPMENT OF AIR POWER—PART I

I(1,0)1

The course is a study of air power from balloons and dirigibles through the jet age; a historical review of air power employment in military and non-military operations in support of national objectives; and a look at the evolution of air power concepts and doctrine. Lt Col Dullen.

29-202 THE DEVELOPMENT OF AIR POWER—PART II

II(1,0)1

Completion of the material described in 29-201. Lt Col Dullen.

29-301 AIR FORCE MANAGEMENT AND LEADERSHIP—PART I

I(3,0)3

An integrated management course emphasizing the individual as a manager in an Air Force milieu. The individual motivational and behavioral processes, leadership, communication, and group dynamics are covered to provide a foundation for the development of the junior officer's professional skills as Air Force officer (officer-ship). The basic managerial processes involving decision-making, utilization of analytic aids in planning, organizing, and controlling in a changing environment are emphasized as necessary professional concepts.

Organizational and personal values, management of forces in change, organizational power, politics and managerial strategy and tactics are discussed within the context of the military organization. Actual Air Force cases are used to enhance the learning and communication processes. Capt Schrag.

29-302 AIR FORCE MANAGEMENT AND LEADERSHIP—PART II

II(3,0)3

Continuation of the material described in 29-301. Capt Schrag.

29-401 NATIONAL SECURITY IN FORCES IN CONTEMPORARY AMERICAN SOCIETY—PART I

I(3,0)3

Aerospace Studies 400 is a full year course focused on the Armed Forces as an integral element of society, with an emphasis on American civil-military relations and the context in which US defense policy is formulated and implemented. Special themes include; societal attitudes toward the military; the role of the professional military

leader-manager in a democratic society; the values and socialization processes associated with the Armed Services; the requisites for maintaining adequate national security forces; political, economic, and social constraints on the national defense structure; the impact of technological and international developments on strategic preparedness; the variables involved in the formulation and implementation of national security policy; and military justice. In each semester, students will be expected to prepare individual and group presentations for the class, write reports, and otherwise participate in group discussions, seminars and conferences. Lt Varhol.

**29-402 NATIONAL SECURITY FORCES IN
CONTEMPORARY AMERICAN SOCIETY—PART II**
Continuation of the material described in 29-401. Lt Varhol.

II(3,0)3

FACULTY OF AEROSPACE STUDIES

Ronald E. Dullen, Lieutenant Colonel, USAF, Professor of Aerospace Studies; B.S., U.S. Air Force Academy; M.S., Southern Methodist University.

Edward R. Ophof, Captain, USAF, Assistant Professor of Aerospace Studies; B.A., University of Nebraska; M.A., University of Oklahoma.

Paul J. Schrag, Captain, USAF, Assistant Professor of Aerospace Studies; B.A., Central Washington State College; M.A., University of North Dakota.

Peter D. Varhol, First Lieutenant, USAF, Assistant Professor of Aerospace Studies; B.A., Grove City College; M.A., Loyola College.

COLLEGE OF LIBERAL ARTS

Patricia A. Goler, Dean

Richard L. Derry, Assistant Dean

At its best, a liberal education involves the active pursuit of truth as well as a knowledge of ourselves as human beings and of the societies we have constructed. It recognizes and utilizes aesthetic quality and curiosity as inherent motives for human learning. It encourages students to achieve the confidence and to acquire the knowledge and skills necessary to face problems and to deal with them realistically, giving attention to their potential consequences for others as well as for themselves. A liberal education should enable students to comprehend, support, and/or criticize society by fostering freedom of thought, social interaction, and a willingness to make decisions based upon an objective evaluation of the situation as well as upon one's own considered personal values. It should result in orderly processes of thought, respect for relevant evidence, and a sense of obligation to test one's own generalizations. In short, it should prepare one to deal with a complex and rapidly changing environment from the special perspective of one's own chosen field.

OBJECTIVES OF THE COLLEGE OF LIBERAL ARTS

The broad objective of a liberal education to the modern world is to develop through the study of the social sciences and the humanities men and women who are open to change and to the challenges of an uncertain future. The liberal arts program in the University of Lowell recognizes the interdependence of human communities and the balance existing between these and the natural world, and it aims at building an understanding of our cultural and scientific heritage while developing the ability to use the concepts and skills of the academic disciplines in a critical and integrated way. Aside from the special vocational implications of the various disciplines, a liberal arts education can assist the individual to function freely, realistically, and creatively, to respond to challenges with aesthetic sensitivity and intellectual curiosity, and to develop a commitment to life-long learning and personal fulfillment. The College of Liberal Arts recognizes that the attainment of those skills and habits of mind which are vital to the fulfillment of both vocational and developmental goals are in great part the consequence of personal motivation. For this reason, students are allowed considerable latitude in developing their programs of study in regular consultation with their faculty advisors.

COLLEGE ORGANIZATION & GOVERNANCE

The College of Liberal Arts is organized into seven departments and is administered by a dean, who is assisted by an advisory council. The seven departments and the Committee for American Studies are responsible for developing course offerings and programs of study. Although the faculty of the College has overall responsibility for all academic policies of the College, the Academic Standards Committee is responsible for enforcing the standards set by faculty and also serves as a review body for suspended students seeking readmission with probationary status.

Dean's Advisory Council (elected) (Academic Year 1982-1983)

Dr. June Gonsalves, History
Dr. Joseph Lipchitz, History
Dr. Martha McGowan, English
Dr. Judith Pastore, English
Dr. William Roberts, English
Mr. Kenneth DeMoura, Student
Ms. Kristin Sylvian, Student (appointed)
Dr. Liana Cheney, Art
Dr. Pilar Concejo, Languages
Prof. Joyce Denning, History
Dr. Linda Silka, Psychology
Dr. Frederick Sperounis, Sociology

Curriculum Committee (Academic Year 1982-1983)

Dr. Heli Hernandez, Languages
Dr. Peter Blewett, History
Dr. Frederick Sperounis, Sociology
Dr. Robert Innis, Philosophy
Dr. Liana Cheney, Art
Dr. Gerard O'Connor, English
Dr. Deborah Schildkraut, Psychology

Academic Standards Committee (elected) (Academic Year 1982-1983)

Dr. Mitra Das, Sociology
Dr. Joseph Garreau, Languages
Dr. Hai B. Pho, History (appointed)
Prof. Anthony Turrisi, English
Prof. Brenda Pinardi, Art
Prof. Joseph Waterman, Psychology

BACCALAUREATE DEGREE PROGRAMS

The College of Liberal Arts offers undergraduate programs leading to the degree of Bachelor of Arts, Bachelor of Science, and Bachelor of Fine Arts. All degree programs of the College provide a broad, comprehensive education with many options for developing major and minor programs and ordinarily provide sufficient preparation for graduate programs which require students to possess a general liberal arts background. Students who matriculate for the degree of Bachelor of Science in the College of Liberal Arts pursue the major program in the administration of law and justice. The Bachelor of Fine Arts degree is offered by the art department.

Dual Degree Program BA/BSE

The College of Liberal Arts and the College of Engineering offer five (5) year dual degree programs which permit the student to earn a Bachelor of Arts degree in one of the following areas of liberal arts: American studies, art, English, languages, history, political science, philosophy, psychology or sociology, while simultaneously earning a Bachelor of Science in Engineering degree in a designated engineering field (plastics, mechanical, civil and chemical).

Students entering the dual degree program must meet the entrance requirements of both colleges. Curricula for dual degree programs are approved by the faculties of the participating colleges and must be completed as prescribed. It is imperative that students entering the Liberal Arts/Engineering dual degree program obtain a copy of the curriculum which enumerates the specific semester by semester course requirements. The curriculum is available from the Dean of the College of Liberal Arts or from the Dean of the College of Engineering.

Both the Bachelor of Science in Engineering and the Bachelor of Arts degrees are conferred at the end of the fifth year. The conferral of the Bachelor of Science in Engineering degree is contingent upon the completion of all the requirements for the degree of Bachelor of Arts.

Minimum Degree Requirements and Baccalaureate Options

All degree programs include the following components:

Requirements	Credits
1. University Core Requirements	33*
2. Liberal Arts Major	30-45
3. Collateral and Elective Requirements +	42-57
Minimum Degree Credits	120

*Does not include physical activities courses, for old core requirements. 36-38 credits are required under revised core requirements.

+ May include specified collateral requirements of the major which are not completed as part of the University Core elective courses, optional minor programs, and second majors.

Students who are matriculating for degrees in the College of Liberal Arts are required to designate degree majors in the College. Students are not required to complete a minimum number of credits or courses in the College and are permitted to elect courses in other colleges of the University which are relevant to the academic orientations of their liberal arts programs. However, courses of a distinctly professional orientation are not applicable to programs of the College and, irrespective of any permissive regulation of another college, they are not accepted for degree credit by the College. Courses for which students can satisfy prerequisite requirements may be elected without the authorization of the Dean of the College of Liberal Arts in the College of Pure & Applied Sciences. Other courses which may be elected without the authorization of the Dean of the College include economics courses of the College of Management Science, music history and literature courses of the College of Music, non-professional health and physical education courses (but not physical activities courses) of the College of Health Professions, and courses of the Department of Aerospace Studies. Foundations of education courses of the College of Education may be credited to programs of the College of Liberal Arts but are not open to students of the College except by permission of the Dean of the College of Education.

Options for second majors and minor studies are permitted as specified below.

1. Students may elect a second major which is offered by the College of Liberal Arts or, upon approval of the Dean of the College of Liberal Arts, they may elect a second major which is offered by other colleges of the University. A second major in American studies is not available as an option to English majors. Nor is a second major in English, history, political science, or sociology available as an option to American studies majors. Students who elect academic majors in more than one college are candidates for one degree only, and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary at the time they make a declaration of second major by filing for intercollegiate transfer. Accordingly, a student who pursues academic majors in the College of Liberal Arts and another college is subject to all degree requirements as specified by the college of his or her initial major and is subject only to major course requirements (including any collateral and prerequisite courses for the major) as specified by the department of his or her second major. For a full discussion of University requirements concerning second majors, students should consult the relevant section of this publication which appears under the heading "Academic Policies."
2. In accordance with the requirements of established minor programs, students who matriculate for degrees in the College of Liberal Arts may undertake a minor from those areas cited below which are distinct from the disciplines comprising their majors. The Curriculum Committee of the College of Liberal Arts will from time to time review and, when appropriate, approve new minors in addition to those listed below. Students should consult with their advisors concerning additions to the approved listing of minors. Specific options for minor programs will depend on the major field which a student has elected to pursue and the collateral course requirements which have been specified by their major departments. Students are advised that an aggregation of courses which total 18 or more credits does not constitute a minor area and they are referred to University policies which appear elsewhere in this publication under the heading "Academic Policies: Minor Area Requirements" for further discussion. Students who wish to elect a minor program in colleges other than the College of Liberal Arts should refer to the appropriate section of this publication concerning prerequisites, restrictions, and prescribed sequences of courses.

American history
American literature
American studies
art history
biology
British history
business
chemistry
classical civilization*
clinical science
coaching#
cognitive science*
drama
economics

earth science
English
English literature
European history
French
German Studies
Greek
health@
Italian Studies
history
Latin American studies*
mathematics (including com-
puter programming option) +

music history and literature
music history and literature
philosophy
physics
political science
psychology
social science
sociology
Spanish
studio art
technology society & human values*
western cultural heritage*
women's studies*

*See listing of interdisciplinary minors at the end of the College of Liberal Arts section of this bulletin.

#Refer to Physical Education department listings in College of Health Professions section of this bulletin.

@Refer to interdisciplinary courses/programs in the College of Health Professions section of this bulletin.

+ Courses for a minor area in mathematics (including the computer programming option) require approval in advance by the chairperson of the mathematics department.

3. With the approval of their faculty advisors, matriculating students in the College of Liberal Arts may develop programs of elective courses for the purpose of providing greater personal and professional relevance to their major fields. Such programs may be developed from among those disciplines which are listed above as areas in which elective courses may be authorized for matriculating students of the College of Liberal Arts.
4. Matriculating students in the College of Liberal Arts who do not choose to take a second major or a minor must present at least six semester credits in courses which are on the "300" level among those elective courses offered in fulfillment of collateral degree requirements.

GENERAL COLLEGE REQUIREMENTS

In order to qualify for a baccalaureate degree offered by the College of Liberal Arts, each undergraduate must comply with the University Core Requirements, must conform to the rules of the College of Liberal Arts which

govern degrees and major studies for such degrees, and must earn a 2.20 average in his or her major area(s) of concentration by the end of the senior year. Students who have failed to achieve a 2.00 average in their major concentrations by the end of the junior year (typically 27 hours in the major of 89 hours undertaken by the end of the junior year) have not made satisfactory progress toward their degrees, and upon the recommendation of appropriate departmental committees and the concurrence of the Academic Standards Committee of the College, such students are dismissed from the University for inadequate scholarship.

Language Proficiency Requirement

The College of Liberal Arts *does not impose a language requirement*, but individual departments & programs may require language proficiency as a part of their published baccalaureate degree standards. Presently, majors in English and the administration of law & justice are required to demonstrate intermediate level proficiency in a foreign language. Students in other majors, particularly those planning graduate study, are strongly advised to develop an intermediate proficiency in one or more languages. Students who desire to present official evidence of language proficiency for purposes of employment or application to graduate schools should consult policies noted under the heading "Academic Policies: Language Requirement" for a listing of avenues by which certification of language proficiency may be pursued.

Declaration of Major and Change of Major

The College of Liberal Arts does not require students pursuing the Bachelor of Arts degree to declare their major fields until the end of their sophomore year. Students should consult policies listed elsewhere in this publication under the heading "Academic Policies: Major Field Requirements" for a complete discussion of declaration of major, declaration of second major, change of major within the college of enrollment, and changes of major with intercollegiate transfer.

Transfer Policies

Students transferring to the College of Liberal Arts from other colleges of the University or from other institutions may expect recognition of previously completed courses if these are equivalent to those which are specified by curricula of the College. *The College of Liberal Arts will not accept in transfer professional courses from any program or curriculum whatsoever, with the exception of credits specifically applicable to the degree program in the administration of law and justice.* Courses of a professional nature which are not relevant to the academic orientation of liberal arts programs or to the specific orientation of the degree program in the administration of law and justice may not be credited to the minimum degree requirement of 120 credits and, irrespective of any previous recognition by the Office of Admissions or by other colleges of the University, they may not be credited to degree requirements in the College of Liberal Arts. (Professional courses of students who transfer to the University into the law and justice program and who subsequently seek intercollegiate transfer to another degree program in the College of Liberal Arts will remain on the student's permanent record but may not be credited to minimum degree requirements).

Transfer from Other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions when a student is admitted to the University. Courses are evaluated by major departments in terms of college and program requirements. Courses which are transferred to the University under provisions of the Massachusetts Transfer Compact and which are not creditable to requirements of the College of Liberal Arts or as unrestricted elective courses will be listed on the student's permanent record card but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University subsequently makes an intercollegiate transfer to the College of Liberal Arts, all previously completed courses, including transferred courses from other institutions, will be reevaluated in terms of their applicability to degree requirements of the College of Liberal Arts. The policy of the College of Liberal Arts is to count courses transferred in the major for the purpose of determining the student's major grade-point average.

Repetition of Transferred Courses

A student who has been granted transfer credit, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form through the office of the college dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Liberal Arts

Students wishing to transfer from another college of the University or from baccalaureate continuing-education programs of the Evening School must file a petition, together with a transcript of their permanent record cards, with the appropriate chairperson and the Dean of the College of Liberal Arts by November 1 for spring semester transfer and by April 1 for fall semester transfer. Students are referred to University policies concerning intercollegiate transfer which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Office of the Dean of the College of Liberal Arts and, irrespective of grades previously received in other college programs, all courses which may not be applied to college or program requirements are deleted from the student's cumulative grade-point average.

COMMITTEE FOR AMERICAN STUDIES

Charles Carroll, Coordinator

Professor: Charles Carroll (History & Political Science), Mary Walsh (Psychology).

Associate Professors: Clifford Lewis (English).

The Committee for American studies administers a major in American studies which leads to the Bachelor of Arts degree. The Committee also administers a minor area in American studies.

American Studies Major

American Studies allows the student who is searching for an understanding of interrelationships among ideas, institutions, and aesthetic forms to combine a number of scholarly disciplines in order to better comprehend the many facets of modern American culture. Although the core of the American studies program is not career oriented, the committee believes that students who combine a variety of disciplines will not only sharpen their analytical powers and increase their sense of self-fulfillment, but will, in the long run, be better prepared for positions in education, government, social services, business, and the professions. For students who are capable of analyzing American culture by combining the conceptual approaches of a variety of disciplines — the arts, history, literature, political science, psychology, economics, sociology — are capable of making decisions with some realization and awareness of the available alternatives. Many current problems involving family life, medical ethics, the status of women and minorities, technology, the environment, government power, and the influence of big business, require an interdisciplinary approach. The American studies program is a method by which students can obtain a broad liberal arts education. At the same time, the committee encourages students to elect career-oriented courses as free electives. Many American studies majors take a portion of their free elective courses in studio art, accounting, management, economics, mathematics, and computer programming. The American studies program is a good program for students who are unsure about their ultimate career choice, for it is extremely flexible and allows for changes in career direction — often without an accompanying loss of time and course credits.

Major Requirements

To fulfill the requirements for a major in American studies, individuals must take 30-45 semester credits (with at least 15 credits at the 300 or 400 levels) including the following courses:

1. 43-305-306 American Intellectual History, or
43-313-314 American Social History.

2. One interdisciplinary course chosen from the list below.
3. Two courses at the 200 level or above in one discipline.
4. Two courses at the 200 level or above in a second discipline.
5. 40-401: American Studies Seminar.

Students transferring to the College of Liberal Arts and wishing to major in American Studies must make individual arrangements with the Chairperson of the Committee regarding satisfaction of major and collateral course requirements.

Interdisciplinary Course Requirements

Students majoring in American studies must take at least one of the following courses. Each course integrates a number of academic disciplines in order to give the student an understanding of the many forces which shape American culture.

- 40/42-313 The Twenties
- 40/42-316 The Thirties
- 40/42-310 The West in American Literature
- 40/43-230 Colonial America: History and Culture
- 40/43-232 The Coming of the American Revolution
- 40/43-324 The Rise of American Industrial Society
- 40/43-270 Women in American History
- 40/43-301 The Gilded Age
- 40/43-302 Progressive America, 190-1930
- 40/43-270 Children and Family in the United States

In addition, specified courses in the following disciplines carry credit for students majoring in American studies: art, economics, education (foundations courses only), English (American literature), geography, history, music, political science, psychology, sociology. Students should consult with the program coordinator for a complete list of approved courses.

Minor Requirements

A minor in American studies consists of 18-24 credits selected in accordance with the following specifications. At least 6 credits must be taken in courses at the "300" level or above.

- a. 53-305, 306, American Intellectual History, or 43-313, 314, American Social History;
- b. Three hours of designated "300" level interdisciplinary courses; and
- c. Nine to fifteen hours in other authorized American studies courses from separate disciplines (above).

American Studies (Course Prefix: 40)

40-133 INTRODUCTION TO AMERICAN CULTURE

The study of major themes in American culture, including relationships between blacks and whites, the success ethic, pastoralism and communalism. Students will explore popular fiction, architecture, painting, autobiography, drama, music, sports, photography, and motion pictures. Lewis. 3 cr.

40-370 COLLOQUIUM IN AMERICAN STUDIES

Emphasis will be on readings, group discussions, and on-the-spot investigations of particular topics in American culture. Students will make field trips, prepare oral and written reports, and become involved in community projects. Permission of the instructor. Carroll, Lewis, Walsh. 3 cr.

Seminar

40-401 AMERICAN STUDIES SEMINAR

A required seminar for American Studies majors, normally taken in the senior year. Students undertake a research project involving more than one discipline. Open to students outside of the American Studies program with the permission of the instructor. Carroll, Lewis, Walsh. 3 cr.

Directed Studies

Directed studies courses are available only to majors in American Studies and may be elected provided that (1) the material to be covered is not available in any course offered during the semester in which the directed studies course is contemplated, (2) instructors are willing to undertake a directed studies course, and (3) no more than 9 credits in the major field are acquired in directed studies courses.

40-491 DIRECTED STUDIES IN AMERICAN STUDIES

Through frequent consultation with the instructor, the student will investigate and define a problem for research, the results of which are presented in a significant paper. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. Carroll, Lewis, Walsh. 3 cr.

40-495 ADVANCED TUTORIAL IN AMERICAN STUDIES

A program of directed studies in which the student through regular consultation with the instructor develops an evaluative and critical essay. The purpose is to sharpen and refine techniques for scholarly research in the student's major discipline. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. Carroll, Lewis, Walsh. 3 cr.

Practicum

40-496 PRACTICUM EXPERIENCE IN AMERICAN STUDIES

The practicum experience allows the student an opportunity to combine formal education with an off-campus project. After developing a proposal for the practicum under the guidance of an instructor, the student spends a major portion of his time dealing with persons engaged in business, the arts, the professions, or government and community service. The American Studies Coordinator keeps a file on individuals, groups, and agencies who will accept practicum students. 3 cr.

DEPARTMENT OF ART

Fred Faudie, Chairperson

Professor, Carlton Plummer

Associate Professors: Fred Faudie, Leo Panas, Brenda Pinardi

Assistant Professors: Liana Cheney, James Coates, Robert Griffith

Art Majors

The art major aims at helping the individual develop a discriminating appreciation of the art world and technical capacities for creating art works. The Department of Art offers two options for art majors which lead to the Bachelor of Arts degree and a third option which leads to the Bachelor of Fine Arts degree. The Department also offers minor programs in art history and in studio art. A major in art provides students the opportunity to prepare for careers in fine arts, commercial art, community oriented programs, gallery work, museum research photography related occupations, and teaching, and for graduate programs in art history, art education and studio art.

Bachelor of Arts: Major Requirements

Option I (General Art Program).

This option is general in nature and includes courses in both studio art and in art history, and is sufficiently flexible to permit students who have a desire to major in another area to do so. By pursuing a degree program which includes majors in both art and second discipline, the student can prepare for a variety of professions and can tailor their studies to prepare for specialized graduate work, such as art therapy. Further, with this option students can develop a concentration in art history which will help them prepare for graduate studies in art history or for

work in related fields, such as a museum curator or slide librarian. A major in art which is taken under this option consists of 36-45 credits and must include at least five courses (15 credits) at the 300 level or above plus the following requirements:

1. Four Art History Courses (12 credits)
Survey of Art I* and II*, and two other history electives;
 2. Five Studio Art Courses (15 credits)
Drawing I*, Design I*, Painting I, Photography I, and Printmaking; and
 3. Art Electives (9-18 credits)
Electives in studio art or in art history.
- *All art majors must take Survey of Art I and II, Drawing I, and Design I prior to enrolling in other art courses.

Option II (Studio Art Program)

This option is designed for students who seek both knowledge of the basic art processes and an opportunity to develop skills in one of the following studio art areas: commercial art, drawing and painting, or three-dimensional art. By pursuing an art major under this option, the student can prepare for specific art careers and for graduate study in studio art. In addition to satisfying the requirements for the studio major, students who pursue this option are also required to complete requirements for a minor in art history. These combined studies cannot exceed 63 credits unless the student presents an additional number of credits beyond the 120 credit minimum for the Bachelor of Arts degree which is equal to the number of credits by which he or she exceeds the specified 63 credit maximum. A minimum of 57 credits must be presented in non-art courses.

The major in studio art which is taken under this option consists of 36-45 credits and must include at least five courses (15 credits) at the 300 level or above plus the following requirements:

1. Six Studio Art Courses (18 credits)
Drawing I*, Three Dimensional Design, Painting I, Photography I, and Printmaking;
2. Four Approved Courses in One of the Following Areas of Studio Emphasis (12 credits)
 - a. Commercial Art
 - b. Drawing and Painting
 - c. Three Dimensional Art; and
3. Studio Art Electives (6-15 credits).

The required minor in art history consists of 18-24 credits and must include at least six credits at the 300 level or above plus the following requirements:

1. Two Art History Courses (6 credits)
Survey of Art I*, and II*.
2. Art History Electives (12-18 credits)

*All art majors must take Survey I and II of Art, Drawing I and Design I prior to enrolling in other art courses.

Bachelor of Fine Arts: Major Requirements

This option is designed for students who seek both knowledge of the basic art processes and an opportunity to develop more concentrated skills in one of the following areas of emphasis: Drawing and Painting Emphasis or Commercial Emphasis. By pursuing art under this option, the student can prepare for specific art careers and for graduate study in studio art. In addition to satisfying requirements for studio art courses, students who pursue this option are required to complete an art history component program. The total of art studies cannot exceed 87 credits unless the student presents non-art credits (equal to the number of credits by which they exceed 87 art credit maximum) beyond the 120 credit minimum required for their degree. A minimum of 33 credits must be presented in non-art courses.

The studio art portion of the BFA studies consists of 60-69 credits and must include at least five courses (15 credits) at the 300 level or above, plus the following requirements:

1. Six Studio Art Courses, Art Course (18 credits) Drawing I, Design I, Three Dimensional Design, Painting I, Photography I, Printmaking;
2. Seven Required Courses Within the Chosen Emphasis (21 credits)
 - a. Drawing and Painting Emphasis
Drawing II, Figure Drawing, Painting II, Water Color I, Watercolor II, Color, Advanced Studio;
 - b. Commercial Emphasis
Design II, Silkscreen, Color, Photography II, Commercial Illustration, Advertising Design, Cartooning;
3. Senior Studio Requirements (21 credits)
Courses are chosen with the advice and consent of the student's degree advisors and must include two Advanced Studio Courses (6 credits) and Senior Studio Courses (15 credits). Senior Studio requires an exhibition of the student's work as part of the study. Work will be evaluated by the Art Faculty BFA Committee.

4. The Art History Component of the BFA Studies consists of 18-24 credits and must include at least six credits at the 300 level or above, plus the following requirements:
 - a. Required Art History Courses (6 credits) Survey of Art I and Survey of Art II;
 - b. Art History Electives (12-18 credits).

Between the minimum of twenty-six and the maximum number of twenty-nine art courses required for the BFA studies, the student has three courses (9 credits) which may be chosen from the offerings of the Art Department or may, with the permission of their advisor, be taken outside the department.

Portfolio Requirements

High school students and students with no art credits need not present a portfolio. College students transferring art credits to the Department and wishing to major in art must make individual arrangements with the Chairperson regarding satisfaction of major course requirements. In conjunction with this, students must arrange to present a portfolio of representative work which they have executed at their previous institution for review by the Department of Art.

Minor Requirements

A minor in art history consists of 18-24 credits hours selected in accordance with the following specifications. At least one course must be completed in studio art and no fewer than six credit hours of the minor must be taken at the 300 level or above.

A minor in studio art consists of 18-24 credits in studio art courses. At least one course must be selected in art history and no fewer than six credits of the minor must be taken at the 300 level or above.

Student Policies

Registration for Art Courses

The Department of Art reserves the right to preregister its major students in order to assure completion of their degree requirements. In the event of over-subscription of art courses by art majors, the Department will grant first preference to seniors and second preference to juniors.

Policy Concerning Student Work

The Department of Art reserves the right to keep student work for a period not exceeding one year for inclusion in exhibitions. All work will be returned.

The Department reserves the right either to photograph student work for its slide collection or, in the case of photography and printmaking courses (where many copies can be made) to keep actual examples of work.

Unless otherwise specified, art work and term papers left for more than one semester following the semester in which they were completed become the property of the Department to do with as it sees fit.

Art Studio (Course Prefix: 57)

57-241 VISUAL DESIGN I STUDIO

A study of design principles and how they articulate structure, space and form. The development of visual ideas that relate to painting, sculpture, graphic arts and architecture. Griffith.

3 cr.

57-253 THREE DIMENSIONAL DESIGN STUDIO

The course will explore the basic conditions that underline other three dimensional disciplines. A variety of materials will be used in order to introduce students to concepts and the basic principles of designing in space.

3 cr.

57-255 DRAWING I STUDIO

A foundation course in basic concepts and techniques using a variety of drawing media. The emphasis is on realism and its application to the realm of ideas. A wide range of assignments are given to develop graphic expression. Pinardi. 3 cr.

57-261 PHOTOGRAPHY I STUDIO

An introduction to photography with an emphasis on photographic composition and pictorial elements. Basic darkroom techniques for black and white photography will be covered. Students learn to develop and print black and white photographs. Faudie. 3 cr.

57-267 PRINTMAKING STUDIO

An introduction to graphic techniques and expression, including relief and intaglio processes. The approach is creative rather than directed, emphasizing experimentation and exploration in many areas of printmaking. Griffith. 3 cr.

57-271 PAINTING I STUDIO

Oil painting techniques are taught as vehicles for serious creative expression. A variety of assignments will be given to help the student gain proficiency in the use of color, technique and subject matter. Pinardi, Plummer. 3 cr.

57-273 WATERCOLOR I STUDIO

Geared to developing the student's ability to use transparent and opaque water colors and related media in a fresh and direct manner. A variety of techniques are within the capabilities of each individual. Plummer. 3 cr.

57-275 SCULPTURE I STUDIO

The exploration of three dimensional forms through the use of basic materials, methods and approaches. Assignments will include expressive problems based on the human and non-objective form relationships. 3 cr.

57-281 CERAMICS I STUDIO

The course is designed to introduce students to the design and production of basic handbuilt pottery using pinch, coil and slab techniques. Students will learn the basic nature and properties of clay, glazing and firing. 3 cr.

57-287 ART AND THE CHILD STUDIO

A lecture-studio course that analyzes the creative force in children and considers how such force can be directed towards meaningful art expression. Panas. 3 cr.

57-351 VISUAL DESIGN II STUDIO

An advanced course in drawing and an outgrowth of Drawing I. The course includes a wide range of media and subject matter with emphasis on development of personal expression and style. Drawing on location weather permitting and working in a studio situation with models and still life will constitute a major portion of this course. Prerequisite: 57-255 or permission of instructor. Plummer. 3 cr.

57-355 DRAWING II STUDIO

An advanced course in drawing and an outgrowth of Drawing I. The course includes a wide range of media and subject matter with emphasis on development of personal expression and style. Drawing on location weather permitting and working in a studio situation with models and still life will constitute a major portion of this course. Prerequisite: 57-255 or permission of instructor. Plummer. 3 cr.

57-357 FIGURE DRAWING STUDIO

Emphasis is on drawing the draped and undraped figure, stressing sound observations and effective creative presentation. Development of personal style is emphasized. Prerequisite: 57-255 or permission of instructor. Pinardi, Plummer. 3 cr.

57-359 SCULPTURE II STUDIO

A course allowing the student to further develop his or her techniques and understanding of sculptural form, leading to a more personal vocabulary. Conventional techniques will be extended to cover more contemporary materials and methods. 3 cr.

57-361 PHOTOGRAPHY II STUDIO

Advanced black and white techniques, introduction to use and development of color, and help in developing a personal photographic vision. Prerequisite: 57-261 or permission of instructor. Faudie. 3 cr.

57-363 FILM MAKING

An introduction to making movies structured upon inexpensive super-8 equipment. Aspects of basic camera use, composition, lighting, animation and similar elements will be covered. Essential equipment is furnished. Faudie.
3 cr.

57-368 SILKSCREENING STUDIO

A course in the fundamentals of silk screen process. Techniques will include paper and film stencil and photographic process. Students are encouraged to explore subject matter and images through imagination and to develop competency in color mixing and in making silk screen prints. Griffith.
3 cr.

57-369 COLOR STUDIO

A course in the systematic study of color and color theory to sharpen visual acuity, stimulate creativity and develop a greater facility in the use of color. Griffith.
3 cr.

57-371 PAINTING II STUDIO

The course is designed to allow students to develop individual style through a variety of problems, both self-initiated and assigned by the instructor. Faudie, Pinardi, Plummer.
3 cr.

57-372 CARTOONING STUDIO

The course is designed to develop skills and techniques essential for appreciating and producing cartoon forms for publication and advertising. Special topics to be covered are politics, sports, panel humor, advertising and comic strips. Original cartoon work will be done in black and white, and color; using overlays, hand and transfer lettering. Prerequisite: 57-255 or permission of instructor. Panas.
3 cr.

57-373 WATERCOLOR II STUDIO

An outgrowth of Watercolor I stressing the development of a personal style and approach to both technique and subject. Mixed media techniques will be encouraged. Prerequisite: 57-273 or permission of instructor. Plummer.
3 cr.

57-381 CERAMICS II STUDIO

This course allows students to advance their understanding of basic handbuilding principles while stressing wheel throwing techniques. Students will also be involved in glaze formulation and several kiln firing procedures. Prerequisite: 57-281 or permission of instructor.
3 cr.

57-373 COMMERCIAL ILLUSTRATION

This course provides students with a variety of experiences involving skills and techniques related to the execution of illustrations for children's books, fashion drawings, record albums, book jackets, folders, posters and magazines. Field trips, discussions related to job opportunities and preparation of portfolios are integral parts of the instruction. Prerequisite: 57-251 and/or 57-255 or permission of the instructor. Plummer.
3 cr.

57-395 ADVERTISING DESIGN STUDIO

Instruction in lettering, layout of commercial media as well as in the creative aspects of advertising are an integral part of the course. Practical problems, field trips and technical guidance from preliminary layouts to finished work will help prepare students for the commercial art field. Prerequisite: 57-251 and/or 57-255 or permission of instructor.
3 cr.

57-492 ADVANCED STUDIO

In order to enable students to expand expression in areas of their choice, they may repeat any studio course that is the most advanced offered in that given subject. They will be given more freedom within assignments and be expected to perform on a more advanced level. Prerequisite: permission of instructor.
3 cr.

Directed Studies

Directed studies courses are available only to art majors and may be elected provided that (1) the material to be covered is not available in departmental course offerings, (2) instructor is willing to undertake a directed studies course, and (3) no more than six hours of credit in the major field is acquired through registration for a completion of directed studies courses, excluding Senior Studio.

57-494 DIRECTED STUDY IN STUDIO ART

A special problem in Studio Art is investigated through conference and studio work. Prerequisite: permission of instructor.
3 cr.

57-495 ADVANCED TUTORIAL IN STUDIO ART

A program of directed studies which afford the advanced students with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine skill, content and presentation. Prerequisites: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

57-496 PRACTICUM EXPERIENCE IN STUDIO ART

A program of on-campus and/or off-campus experiences for art majors only. Specific requirements will vary depending upon departmental policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and/or for learning of skills through temporary placement in the field. All Practicum Experiences must be approved by the Department of Art, and may be repeated to a maximum of nine credit hours. Practicum Experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson and supervising instructor. 3 cr.

57-499 SENIOR STUDIO

This course is designed to culminate four years of art experience for the BFA studies. The development of personal approach to media and idea is emphasized. Each student will be responsible for developing a self-assigned thematic concern. No assignments will be made by the instructor who will act only as an advisor and coordinator. Course grade will be assigned by a committee of faculty members. Enrollment restricted to majors in BFA program. 3 cr.

Art History (Course Prefix: 58)

58-101 APPRECIATION OF THE VISUAL ARTS

An analysis of the visual elements used in art such as color, line and shape. Emphasis is placed on modes of representation, styles, media, technical procedures and principles of design. Cheney. 3 cr.

58-203 SURVEY OF ART I

A survey of the major Western arts from earliest time to the Middle Ages presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. First semester. Cheney. 3 cr.

58-204 SURVEY OF ART II

A survey of the major Western arts from Renaissance to the 20th Century presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. Second semester. Cheney. 3 cr.

58-211 NINETEENTH CENTURY ART

A study of 19th Century European painting, sculpture, and architecture including the art of Neoclassicism, Romanticism, Realism, Impressionism, Post-Impressionism, Symbolism and Art Nouveau. Cheney. 3 cr.

58-221 TWENTIETH CENTURY ART

A study of American and European movements in painting, sculpture and architecture from 1900 to the present. Emphasis is placed on Fauvism, Cubism, Expressionism, Surrealism, International Style, Pop, Op Art, Minimal Art and Photorealism. Cheney. 3 cr.

58-225 HISTORY OF PHOTOGRAPHY

A survey of photography with emphasis on key figures in its development. Photography is treated as an art-form and is compared to related non-photographic art movements. Includes the beginnings of the moving-picture phenomena. Faudie. 3 cr.

58-231 GREEK AND ROMAN ART

A study of Greek painting, sculpture and architecture from the Cycladic to the Hellenistic period, and an examination of Roman Art from the Etruscan Age to the beginning of Christian art. Emphasis is placed on the Greek Classical period and the Roman Empire. Cheney. 3 cr.

58-241 MEDIEVAL ART

A survey of architecture, sculpture and painting of Early Christian, Byzantine, Carolingian, Romanesque and

Gothic periods from the 4th to the 13 Centuries. Emphasis on Hagia Sophia, Aachen Chapel, Saint Denis and the French cathedrals. Cheney. 3 cr.

58-313 AMERICAN ART

The study of American painting, sculpture and architecture from the Colonial Period to the end of the 19th Century seen in relation to European developments and American social and technological changes. Emphasis is placed on New England architecture. Cheney. 3 cr.

58-321 ITALIAN RENAISSANCE ART

A study of painting, sculpture and architecture in Florence, Rome and Venice during the 15th and 16th Centuries. Special emphasis on the formation of the High Renaissance style and the role of representative artists of the period: Leonardo, Michelangelo and Raphael in Central Italy; Giorgione and Titian in Venice. Cheney. 3 cr.

58-323 NORTHERN RENAISSANCE ART

Development of Flemish and Dutch painting from the brothers Van Eyck and Rogier Van der Weyden to Bosch and Breughel, from the late 14th Century to mid-16th Century. The course will also include a study of German painters of the same period: Durer, Grunewald and Holbein. Cheney. 3 cr.

58-332 BAROQUE ART IN ITALY

The development of painting, sculpture and architecture in Italy during the 17th Century with special emphasis on Rome. The role of representative artists (Caravaggio, Bernini, Borromini, Pietro da Cortona) is emphasized. Cheney. 3 cr.

58-334 NORTHERN BAROQUE ART

The examination of 17th Century painting outside Italy with emphasis upon Dutch, Flemish, Spanish and French Art. The role of representative artists of the period (Rembrandt, Rubens, Velazquez and Poussin) is emphasized. Cheney. 3 cr.

58-340 WOMEN AND ART

Investigation of the various ways women have been portrayed in the visual arts from antiquity to the present. A chronological examination of selected female artists and their milieu from the Middle Ages to the 20th Century. Cheney. 3 cr.

58-490 ART HISTORY SEMINAR

Study of particular artist, style or selected art historical problem. Topics to be announced. Course may be repeated. Prerequisite: permission of instructor. 3 cr.

Directed Studies

Directed study courses are available only to art majors and may be elected provided that (1) the material to be covered is not available in departmental course offerings, (2) instructor is willing to undertake a directed study course, and (3) no more than 6 hours of credit in the major field is acquired through registration for and completion of directed study courses. 3 cr

58-494 DIRECTED STUDY IN ART HISTORY

An individual supervised research project relating to stylistic, thematic or methodological issues in Art History, the result to be presented in a significant paper. Prerequisite: permission of instructor. 3 cr.

58-495 ADVANCED TUTORIAL IN ART HISTORY

A program of directed studies which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate and investigate an additional problem. The purpose is to sharpen and refine skills for scholarly research and presentation. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

58-496 PRACTICUM EXPERIENCE IN ART HISTORY

A program of on campus and/or off campus experiences for art majors only. Specific requirements will vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem solving and/or credits. Students will be graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of the Department Chairperson and supervising instructor. 3 cr.

DEPARTMENT OF ENGLISH

Gerard W. O'Connor, Chairperson

Professors: William C. Burto, Emeritus, Robert Foy, Charles Jarvis, Howard Moor, Emeritus, Gerard O'Connor, Robert Stein, Roger Wiehe, Joseph Zaitchik

Associate Professors: William Aiken, Donald Berry, Robert DeYoung, Arthur Friedman, Herbert Haber, Marianne Knowlton, Mary Kramer, Clifford Lewis, Barbara Miliaras, John Riley, William Roberts, Francesca Tillona

Assistant Professors: Andrea Corbett, William Coughlin, Arthur Dabilis, Richard Forster, Robert Griffin, William Hersey, Lester Hudson, David Landman, John McCaffrey, Martha McGowan, Judith Pastore, Charles Ryan, Gardner Tillson, Anthony Turrisi

Instructor: William Gallagher

The Department of English offers a major in English which leads to the Bachelor of Arts Degree. The Department also offers a general minor in English and specialized minors in English literature, American literature, and drama.

The English Major

(30-45 credits) has within it two separate concentrations: one in literature, the other in writing. The requirements for both concentrations are similar in the following two ways: both require an intermediate proficiency in a foreign language and both require the following seven courses:

- 42-201 Great Books of Antiquity
 - 42-291 History of English Literature I
 - 42-292 History of English Literature II
 - 42-293 History of American Literature I
 - 42-294 History of American Literature II
 - 42-307 History and Development of the English Language,
- or:
- 42-308 Analysis of Modern English, or:
 - 42-309 Introduction to Semantics
 - 42-423 Shakespeare I, or:
 - 42-424 Shakespeare II

Additionally, both concentrations require 15 departmental credits at the 300 level and limit 200-level department credits to 6.

The literature concentration also requires two period courses, one course from two of the following three categories:

- Medieval and Renaissance
- Restoration and Neoclassical
- Romantic and Victorian

The writing concentration does not require the two literature period courses, but instead requires Professional Writing and the Practicum or internships, plus four courses from an approved list. Students may obtain this list from the Director of the Writing Concentration, Dr. Herbert Haber.

Minor Requirements

American Literature

A minor in American literature consists of 18-24 credits selected in accordance with the following specifications. At least 6 credits of courses must be taken at the 300 level or above.

- 42-293 History of American Literature I
- 42-294 History of American Literature II
- 42-291 History of English Literature I; or
- 42-292 History of English Literature II
- Electives in American Literature

Drama

A minor in drama consists of 18-24 credits selected in accordance with the following specifications. At least 6 credits of courses must be taken at the 300 level or above.

42-218 Comedy
 42-219 Tragedy
 42-423 Shakespeare
 42-242 Shakespeare
 Electives in Drama
 Electives in stagecraft or acting

English (General English Minor)

A minor area of study consists of 18-24 credits of course work selected in accordance with the following specifications and including 6 credits of courses which are numbered 300 level or above.

42-291 History of English Literature
 42-292 History of English Literature II
 42-423 Shakespeare or 42-424: Shakespeare
 One course in American literature
 English electives

English Literature

A minor area of study consists of 18-24 credits of course work selected in accordance with the following specifications and including 6 credits of courses which are numbered 300 level or above.

42-291 History of English Literature I
 42-292 History of English Literature II
 42-423 Shakespeare or 42-424: Shakespeare
 Electives in English literature

English (Course Prefix: 42)

42-100 FUNDAMENTALS OF ENGLISH

A study of the fundamentals of the English language including vocabulary, grammar, sentence structure and composition, paragraph development and organization. 3 cr.

42-101 COLLEGE WRITING I

An intensive review of grammar and usage, and an introduction to rhetorical technique, the art of writing 3 cr.

42-102 COLLEGE WRITING II

A continuation of 101, introducing students to the more advanced rhetorical modes and to the symbolic use of language. Prerequisite: 42-101 3 cr.

42-103 COLLEGE WRITING FOR INTERNATIONAL STUDENTS

Equivalent to 42-101, for students who speak English as a second language. Credit for both 42-101 and 103 may not be granted. 3 cr.

42-104 COLLEGE WRITING II FOR INTERNATIONAL STUDENTS

Equivalent to 42-102, for students who speak English as a second language. Credit for both 42-102 and 42-104 may not be granted. 3 cr.

Before enrolling in any advanced English course, students must complete 42-101 and 42-102 to fulfill the University requirement of 6 hours in composition. For English Majors, 42-102 is co-requisite with 42-201. 3 cr.

42-201 GREAT BOOKS OF ANTIQUITY

Representative literary selections from the Bible, classical Greece and imperial Rome. 3 cr.

42-202 GREAT BOOKS OF THE MIDDLE AGES AND RENAISSANCE

Representative literary selections of the Middle Ages and Renaissance. 3 cr.

42-203 GREAT BOOKS OF THE MODERN PERIOD

Representative literary selections from the period of the Enlightenment to the present. 3 cr.

42-210 DRAMA

A study of selections from the classical through the contemporary periods. 3 cr.

- 42-211 POETRY
A study of selections from the renaissance through the contemporary periods. 3 cr.
- 42-212 THE SHORT STORY
A study of the development of the genre. 3 cr.
- 42-213 BIOGRAPHY
A study of selections from Boswell to the present, with emphasis on biography and autobiography as a source of ideas. 3 cr.
- 42-214 SATIRE
A study of selections from the classical through the contemporary periods, including satire in the media. 3 cr.
- 42-215 THE MODERN ESSAY
A study of the essay as the literature of ideas. Concentration on twentieth century writers with attention to early examples of the *genre*. 3 cr.
- 42-216 THE SHORT NOVEL
A study of nineteenth and twentieth century short novels as a literary *genre*. 3 cr.
- 42-217 THE HORROR STORY
A study of the genre from Poe to the present. 3 cr.
- 42-218 COMEDY
A study of the theory and practice of comedy from the Greeks to the present. 3 cr.
- 42-219 TRAGEDY
A study of the theory and practice of tragedy from the Greeks to the present.
- 42-221 LITERATURE FOR CHILDREN AND ADOLESCENTS
A study of literature intended for elementary and secondary school age readers. 3 cr.
- 42-224 BUSINESS WRITING
A study of the theory and practice of letters, memoranda, and reports on specific business and technical problems. Restricted to students enrolled in the College of Management Science. 3 cr.
- 42-225 TECHNICAL AND SCIENTIFIC WRITING
A study of the theory and practice of letters, memoranda, and reports on specific scientific and technical problems. Enrollment is limited to students who are required to take the course. With the permission of the instructor, other students enrolled in the College of Engineering and Pure and Applied Sciences may take the course on a space available basis. 42-226 3 cr.
- 42-226 ORAL BUSINESS COMMUNICATION
A study of the theory and practice of oral communication techniques useful in business and industry, including attention to non-verbal communication, management through communication analysis and small group leadership. Prerequisite: Permission of instructor. 3 cr.
- 42-230 ELEMENTS OF FILM
A study of the elements of film as revealed in selected film classics with emphasis on analysis and evaluation. 3 cr.
- 42-240 LITERATURE AND WOMEN
A survey of literary attitudes towards women, from the Judiac and Hellenic periods through the present day. 3 cr.
- 42-241 WOMEN IN FILM
A survey of the image of women in commercial film from the beginnings to the present with emphasis upon the films of the 1930's and '40's and the 1970's and 80's. In addition, to class viewing, several commercial viewings will be scheduled. *A lab fee will be assessed to defray film rental costs.* 3 cr.
- 42-242 THE HEROINE IN MODERN FICTION
A study of selected short stories and novels which deal sympathetically with the changing roles of women. 3 cr.
- 42-243 CONTEMPORARY WOMEN WRITERS
A study of recent work in the novel, short story, drama and poetry by British and American women. 3 cr.

42-246 THE ROGUE IN FICTION

A study of the picaresque hero depicted by such writers as Cervantes, Defoe, Fielding, Cary, Donleavy, and Bellow, including attention to theories of comedy. 3 cr.

42-250 THE BIBLE AS LITERATURE

A literary and historical analysis of selected Old and New Testament books. 3 cr.

42-253 THE LITERATURE OF SPORTS

A study of the athlete as hero in selected novels, biographies, and autobiographies. 3 cr.

42-257 THE FAMILY IN LITERATURE

A study of literary selections dealing with traditions of family life and social change. 3 cr.

42-259 PROTEST FICTION IN AMERICA

A study of American fiction concerned with the oppression of blacks, working people and the poor. 3 cr.

42-260 STAGECRAFT

A study of the theory and practice of the theater arts, including such work-shop activity as scenery, designing, building, painting, and lighting. 3 cr.

42-261 ACTING

A study of the theory and practice of acting, including exercises in the elements and methods of acting and the preparation of a public performance. 3 cr.

42-263 MODERN AMERICAN DRAMA

A study of such playwrights as O'Neil, Odets, Wilder, Williams, and Miller. 3 cr.

42-265 MODERN BRITISH DRAMA

A study of modern British playwrights such as Shaw, Eliot, Fry, and Osborne. 3 cr.

42-267 INTRODUCTION TO SHAKESPEARE

A study of selected histories, comedies, and tragedies. 3 cr.

42-270 CONTEMPORARY AMERICAN FICTION

A study of writers since World War II: Barth, Bellow, Malamud, Mailer, Vonnegut, and Pynchon, among others. 3 cr.

42-271 CONTEMPORARY BRITISH FICTION

A study of writers since World War II: Amis, Lessing, Orwell, Powell, Sillitoe, and Waugh, among others. 3 cr.

42-274 LITERATURE OF THE BEAT MOVEMENT

A study of the Beat rebellion in the context of the 50's and 60's in America, including such writers as Burroughs, Corso, Ferlinghetti, Ginsberg, and Kerouac. 3 cr.

42-275 MODERN IRISH LITERATURE

A study of Irish writing from 1890 to the present, with emphasis on the works of Yeats, Synge, O'Casey, O'Connor and O'Faolain. 3 cr.

42-291 HISTORY OF ENGLISH LITERATURE I

A study of the historical development of English literature from the beginnings to Milton. 3 cr.

42-292 HISTORY OF ENGLISH LITERATURE II

A study of the historical development of English literature from Dryden to the beginning of the twentieth century. 3 cr.

42-294 HISTORY OF AMERICAN LITERATURE

A study of the historical development of American literature from the Colonial Period to the Civil War. 3 cr.

42-295 HISTORY OF AMERICAN LITERATURE II

A study of the historical development of American literature from the Civil War to World War I. 3 cr.

42-296 HISTORY OF AMERICAN LITERATURE III

A study of twentieth century American short stories, novels, poetry and drama. 3 cr.

42-300 JOURNALISM

Writing for the news media

3 cr.

42-301 COMMUNICATING IN BUSINESS

This course examines: (1) the interdependence of speaking and listening and of writing and reading in the variety of communication media used in business; (2) the appropriateness of communication options; and (3) strategies and techniques to ensure effective communication.

3 cr.

42-302 CREATIVE WRITING IN FICTION

A study of the theory and practice of fiction; conducted as a workshop with close analysis of student's work.

3 cr.

42-304 CREATIVE WRITING IN PLAYWRITING

A study of the theory and practice of playwriting; conducted as a workshop with close analysis of student's work. Instructor's permission required.

3 cr.

42-305 THE WRITING OF CRITICISM

A study of the theory and practice of critically reviewing the popular arts, including film, television and theatre; conducted as a workshop with close analysis of student's work. Instructor's permission required.

3 cr.

42-306 PROFESSIONAL WRITING

An introduction to writing for business, government, and the professions. Topics include copywriting and editing, resumes, memoranda, letters, instructions, reports and proposals.

3 cr.

42-307 HISTORY AND DEVELOPMENT OF THE ENGLISH LANGUAGE

A study of the phonetic, lexical, syntactical, and semantic shifts in the English language from its beginning to the present.

3 cr.

42-308 ANALYSIS OF MODERN ENGLISH

A survey of applied linguistics, including structural, traditional and transformational grammars, and such related areas as sociolinguistics, dialectology, and basic semantics.

3 cr.

42-309 SEMANTICS

A study of the symbolic nature of language, the many factors and contexts which determine meaning, the ways in which language affects human behavior, and the semantics of various types of propaganda.

3 cr.

42-310 THE WEST IN AMERICAN LITERATURE

A study of images of the American West as developed by such writers as Berger, Cooper, Howe, Stegner, Steinbeck, and West, and by Hollywood mythmakers.

3 cr.

42-311 THE SOUTH IN AMERICAN LITERATURE

A study of the writers, movements, and social cultures of the South, including such representatives as Douglass, Hellman, Faulkner, Ransom, the Fugitives, Warren, King and Moody.

3 cr

42-312 AMERICAN PURITANISM AS A LITERARY INFLUENCE

A study of puritan values as seen in selected colonial writings, and in confrontation with other values in nineteenth century literature.

3 cr.

42-313 REALISM AND NATURALISM IN AMERICAN FICTION

A study of realistic and naturalistic fiction from the end of the Civil War to the beginning of World War I.

3 cr.

42-314 THE TWENTIES IN AMERICA

A study of the literature, art, and music produced during the decade. Readings will include the works of Anderson, Faulkner, Fitzgerald, Hemingway, Pound, and Stein.

3 cr.

42-315 THE THIRTIES IN AMERICA

A study of the literature, art, and music produced during the decade. Readings will include the works of Dos Passos, Steinbeck, West, and Wright.

3 cr.

42-317 BRITISH LITERATURE OF THE TWENTIETH CENTURY

A study of twentieth century British short stories, novels poetry, and drama.

3 cr.

42-320 CONTINENTAL FICTION

A study of works (in translation) by such authors as Flaubert, Gide, Camus, and Sartre; Dostoevsky, Tolstoy,

- and Zamyatin; Pirandello and Moravia; Kafka, Mann, and Hesse. 3 cr.
- 42-321 THE LITERATURE OF RELIGIOUS EXPERIENCES**
A study of literary accounts of religious experiences entailing a variety of beliefs. 3 cr..
- 42-322 LITERATURE AND SCIENCE**
A study of literary works from the classical through the contemporary periods that deal with science and its cultural implications; topics will include "the two cultures," the scientists as hero, and science fiction. 3 cr.
- 42-323 LITERATURE AND PSYCHOLOGY**
A study of writers and their works in the light of a psychological perspective derived from Horney, Maslow, and Erikson; among authors to be studied are Sterne, Dickens, Trollope, Lawrence, Woolf, Conrad, Tolstoy, Chekhov, and Kafka. 3 cr
- 42-325 THE RISE OF THE NOVEL**
A study of the British novel in the eighteenth century from Defoe through Austen. 3 cr.
- 42-326 THE NINETEENTH CENTURY BRITISH NOVEL**
A study of the novel from Scott through Hardy. 3 cr.
- 42-330 THE TWENTIETH CENTURY BRITISH NOVEL**
A study of the novel from Conrad through Greene. 3 cr.
- 42-331 AMERICAN NOVEL TO 1900**
A study of the American novel from its colonial beginnings through the nineteenth century. 3 cr.
- 42-332 AMERICAN NOVEL OF THE TWENTIETH CENTURY**
A study of the American novel from 1900 to the present. 3 cr.
- 42-345 THE FEMALE ENGLISH NOVELIST**
A study of selected novels by Austen, the Brontës, Eliot, Woolf, Bowen, and Drabble. Attention will be given to the changes in the female writer's situation from the eighteenth century to the present. 3 cr.
- 42-346 FOUR ABSURDIST DRAMATISTS**
A study of selected plays by Albee, Beckett, Ionesco, and Pinter, and the origins of the Theater of the Absurd. 3 cr.
- 42-351 LITERATURE OF THE MIDDLE AGES**
A study of the prose and poetry of England from 1200-1500, excluding Chaucer. 3 cr.
- 42-352 LITERATURE OF THE SIXTEENTH CENTURY**
A study of English prose and poetry of the sixteenth century, excluding drama. 3 cr.
- 42-353 LITERATURE OF THE SEVENTEENTH CENTURY**
A study of English prose and poetry of the eighteenth century, excluding Milton. 3 cr.
- 42-354 LITERATURE OF THE EIGHTEENTH CENTURY**
A study of English prose and poetry of the eighteenth century. 3 cr.
- 42-355 LITERATURE OF THE ROMANTIC PERIOD**
A study of English poetry and prose of the Romantic Period: 1798-1832. 3 cr.
- 42-356 LITERATURE OF THE VICTORIAN PERIOD**
A study of English poetry and prose of the Victorian Period: 1832-1901. 3 cr.
- 42-361 RESTORATION COMEDY**
A study of plays by Congreve, Etherege, Farquhar, Vanbrugh, and Wycherly, and their influence upon the later eighteenth century. "Laughing Comedies" of Goldsmith and Sheridan. 3 cr.
- 42-362 MODERN DRAMA**
A study of selected continental, British and American plays of the late nineteenth century to the present. 3 cr.
- 42-363 ELIZABETHAN AND JOCOBEAN DRAMA (Exclusive of Shakespeare)**
A study of the majors dramatists of the Age of Shakespeare and immediately after Marlowe, Dekker, Webster, Jonson, Beaumont and Fletcher, Massinger, Ford, and others. 3 cr

42-370 MODERN POETRY

A study of the development of English and American poetry from 1900 through World War II. 3 cr.

42-374 CONTEMPORARY AMERICAN POETRY

A study of selected poets since World War II. 3 cr.

42-381 THE EXISTENTIAL HERO

A study of the development of the existential hero in selected works by Stendal, Melveke, Dostoevski, Hemingway, Gide, Sartre, Camus, and Beckett. 3 cr.

42-383 REGIONAL PERSPECTIVES IN WOMEN'S LITERATURE

A research course which will use primary published and unpublished works by women authors of the New England area to provide a heightened historical perspective of the contribution of New England to the growth of the region. 3 cr.

Restricted Courses

The following courses are recommended for English majors only.

42-401 SELECTED AUTHORS

A study of the works of selected major authors; to be announced each semester. 3 cr.

42-421 CHAUCER

A study of the major works of Chaucer. 3 cr.

42-423 SHAKESPEARE I

A study of selected histories, comedies, and tragedies. 3 cr.

42-424 SHAKESPEARE II

A study of selected histories, comedies, and tragedies not covered in 42-423. Readings from 423 and 424 to be announced each semester. 3 cr.

42-426 MILTON

A study of the major poems and of selected prose. 3 cr.

42-430 LITERARY CRITICISM

A study of the major statements about literature from Plato and Aristotle through contemporary critics. 3 cr.

42-431 CONTEMPORARY LINGUISTIC THEORY

A study of contemporary linguistic theory. 3 cr.

Directed Studies

The Department offers directed studies for English majors only. Students may enroll in these courses provided that (1) they have at least a 3.00 average for English courses, (2) the material to be covered is not available in any English course offered during the semester in which directed studies is contemplated, (3) instructors are willing to undertake a directed studies, and (4) arrangements for directed studies are made through the Chairperson. A maximum of 6 credits in the major field may be acquired through registration for directed studies courses.

42-491 DIRECTED STUDY IN LITERATURE

The student develops a course of directed reading in literature, defines a problem for individual research, and prepares a paper or papers. 3 cr.

42-492 DIRECTED STUDY OF LANGUAGE ANALYSIS

The student develops a course of directed readings in linguistics, semantics, or stylistics, and defines a problem for individual research. 3 cr.

42-493 DIRECTED STUDY IN CREATIVE WRITING

The student develops a series of projects in creative writing and writes poetry, fiction, or drama. 3 cr.

DEPARTMENT OF HISTORY AND POLITICAL SCIENCE

Frederick Lewis, Chairperson

Professors: Christos Bantas, Mary Blewett, Charles Carroll, John Duff, Patricia Goler, Joseph Lipchitz, Arthur Miller, Francis Walsh;
Associate Professors: Peter Blewett, Joyce Denning, Richard Derry, Renee Kasinsky, Frederick Lewis, Jonathan Liebowitz, Alan Lincoln,
Donald Mattheisen, Joan Rothschild, John Shea;

Assistant Professors: Harald Bakken, Dean Bergerson, Eva Buzawa, Barbara Dowd, June Gonsalves, George Luter, A.N. Minton, William Nowlin, H.B. Pho, Miriam Price.

The Department of History and Political Science offers majors in History and in Political Science leading to the Bachelor of Arts degree, and minor programs in American history, British history, European history, history, and political science. In cooperation with other departments, the department offers an interdisciplinary major in criminal justice (the administration of law and justice) which leads to the Bachelor of Science degree, and sponsors interdisciplinary minor programs in Latin American studies and social sciences.

History Major

A major in history provides students with a broad introduction to civilizations of the past and present, including those of antiquity, Europe, America, and the Third World, plus a thorough grounding in the historical process. Through a broad exposure to the complexities shaping the forces of civilization, the history major gains a special perspective by which he or she can view human thought and action while also developing his or her ability to determine bias, to make valid generalizations, to draw valid inferences, and to perceive the significance of fact within the framework of interpretations. The history major provides a meaningful background for those students who desire to enter government service, politics, law, teaching, and business.

The major in history consists of 36-45 credits (with at least 15 credits at the 300 course level or above) and must include the following:

- 43-105 Western Civilization to 1715, and
- 43-106 Western Civilization since 1715
- or
- 43-107 World Civilization I, and
- 43-108 World Civilization II
- plus
- 43-370 Introduction to Historical Method
- 43-432 Research Seminar in History

The Department also requires one course in the Third World*, two courses on or above the 200 level in both European and American History, and two additional courses in either European or American history. The remaining courses for the major may be selected from history course offerings.

*Third world courses. All courses dealing with Asian, African or Latin American history, plus the following courses: 43-246: Afro-American History; 43-228: The American Indian; 43-366: Colonialism and the Third World, 43-367: American Indians in the Twentieth Century.

Students transferring to the College who wish to major in history must make individual arrangements with the Chairperson of the Department regarding satisfaction of major requirements.

Political Science Major

The major in political science is designed to provide a knowledge of the functions and theories of the state and the nature, problems, and development of politics and government on the local, national, and international levels. The courses are designed to help the student develop an understanding of the political process and an ability to analyze political systems, relationships, and problems. Pragmatically, the major affords preparation for social science teaching, graduate education, law school, public administration, public service, and intelligent citizenship.

A major in political science consists of 33-45 credits (with at least 15 credits at the 300 course level or above) and must include the following:

1. 46-101 Introduction to American Politics
2. 46-201 Introduction to Political Analysis
3. A substantial research project, produced in connection with a "400" level seminar course for which at least 3 credits are given.
4. A substantial Practicum Project involving first-hand experience with political life and relationships for which at least 3 credits at the "400" level can be given. Students in teacher-education programs are exempted from this requirement.

The Department also requires at least one course in each of the following sub-areas: (1) American Politics and Law, (2) Comparative and International Politics, (3) Political Thought and Theory. The Department recommends that political science concentrators select supporting course work from economics, history, and sociology and encourages students to develop minor areas of study or supporting concentrations in related social science disciplines.

Students transferring to the College and wishing to major in political science must make individual arrangements with the Chairperson of the Department regarding satisfaction of major course requirements.

Legal-Political Studies

Because many political science majors are interested in pursuing careers in the legal field, the department offers several course opportunities in the area of legal-political studies. In appropriate instances, this may include the arrangement of practicum opportunities that provide exposure to legal practice.

Public Affairs and Public Administration

Many political science majors pursue careers in public affairs on the staffs of elected officials, government agencies, or public interest groups. In the coming years, new opportunities are expected to develop in the private sector as increasing numbers of corporations create or expand their public affairs departments.

For the student with these career interests, a major program with emphasis on courses that provide a useful background of practical and theoretical knowledge may be arranged with the faculty advisor. In appropriate instances, this may include the arrangement of practicum opportunities that provide exposure to public affairs activity and the acquisition of some basic skills utilized in public affairs work.

Public Service: The Administration of Law & Justice Major

Joseph W. Lipchitz, Coordinator.

The Administration of Law and Justice major leads to the degree of Bachelor of Science. This major provides a strong academic background for those students seeking careers in the field of law enforcement administration within the broader framework of a traditional liberal arts education. Thus, courses in the major deal not only with theory but also with police work, the courts and correction system and management problems and techniques in criminal justice.

Basic Requirements

The major in the administration of law and justice consists of at least 36 credits, at which at least 15 credits shall be at the 300 course level or above.

1. Required courses (18 credits) are as follows:

- 44-101 The Criminal Justice System
- 44-131 Principles of Law and the Criminal Justice System
- 44-221 Criminology I
- 44-390 Research Methods of Criminal Justice
- 44-490 Research Seminar in Criminal Justice
- 44-496 Practicum

2. Skills requirement

Students majoring in the administration of law and justice are required to meet proficiency standards in one of the following

Intermediate proficiency in a modern foreign language, preferably Spanish. (Students should consult policies published elsewhere in this bulletin under the heading University Academic Policies: Language Requirement for a list of avenues by which certification of language proficiency may be pursued.)

or

Computer Programming & Statistics, proficiency to be demonstrated by passing a minimum of four courses, twelve semester credits, in the mathematics department from the following approved list:

- 92-209 Basic Programming I
- 92-242 Fortran for Management & Social Sciences
- 92-263 Fortran Programming
- 92-363 Introduction to Data Analysis (Prereq: 92-383)
- 92-383 Introduction to Statistics

3. Collateral requirements

A minimum of six courses, eighteen credits, in relevant upper division courses outside the major are required of all students. In fulfilling this requirement, students will normally select courses from the following approved list; election of non-listed courses requires approval by the program coordinator.

- 57-261 Photography I
- 43-243 American Urban History I
- 43-244 American Urban History II
- 43-308 History of Crime, Social Control and Conflict in the U.S.
- 46-260 Introduction to Public Administration
- 46-345 Constitutional Law and Politics
- 46-347 Civil Liberties, Law and Politics
- 46-372 Alternative Social Organizations
- 47-209 Social Psychology
- 47-232 Psychology of Personality
- 47-355 Community Psychology
- 47-364 Psychology of Crime and Correction
- 48-231 Sociology of the Family
- 48-345 Urban Sociology
- 48-350 Social Service
- 48-361 Sociology of Law and the Criminal Justice System
- 64-306 Urban Economics

Except for:

- 44-101 The Criminal Justice System
- 44-131 Principles of Law & the Criminal Justice System
- 44-221 Criminology I
- 44-222 Criminology II
- 44-261 Juvenile Delinquency,

All courses in the criminal justice major are regarded as professional courses and are not accepted either in transfer or as elective options in other degree programs in the College of Liberal Arts.

Students who transfer to the criminal justice major or to the College of Liberal Arts with the intention of subsequently declaring this major must make individual arrangements with the Program Coordinator regarding satisfaction of major and collateral course requirements.

Program Tracks

There are three areas or tracks in the criminal justice major which a student may elect: enforcement, corrections, or law and the courts. Courses suggested for one track are not exclusive, however, and some cross-over is desirable.

- | | |
|---|------------------------------|
| Enforcement | Law and the Courts |
| 44-101 The C.J. System | 44-101 The C.J. System |
| 44-131 Principles of Law | 44-131 Principles of Law |
| 44-141 Police Functions | 44-221 Criminology I |
| 44-221 Criminology I | 44-234 Criminal Law |
| 44-234 Criminal Law | 44-261 Juvenile Delinquency |
| 44-243 Criminalistics I | 44-321 Criminology II |
| 44-244 Criminalistics II | 44-331 Penal Law |
| 44-261 Juvenile Delinquency | 44-335 Juvenile Court |
| 44-341 Comparative Police Systems | 44-390 Research Methods |
| 44-371 C.J. Mgt. and Planning | 44-490 Research Seminar |
| 44-373 Issues in Police Admin. | 44-496 Practicum |
| 44-354 Probation and Parole | |
| 44-360 Minorities and the Criminal Justice System | Corrections |
| 44-371 Criminal Justice Mgt. and Planning | 44-101 The C.J. System |
| 44-380 Selected Issues | 44-131 Principles of Law |
| 44-390 Research Methods in Criminal Justice | 44-151 Intro. to Corrections |
| 44-490 Research Seminar in Criminal Justice | 44-221 Criminology I |
| 44-496 Practicum | 44-234 Criminal Law |
| | 44-261 Juvenile Delinquency |

44-331 Penal Law
44-351 Alternatives to Corrections
44-354 Probation and Parole
44-371 C.J. Mgt. and Planning

44-372 Issues in Correc. Admin.
44-390 Research Methods
44-490 Research Seminar
44-496 Practicum

Minor Requirements

American History

A minor in American history consists of 18-24 credits. At least 6 credits must be taken in courses at the 300 level or above. Course work is selected in consultation with the faculty advisor.

British History

A minor in British history consists of 18-24 credits in the history of England and the British Empire-Commonwealth with at least 6 credits at the 300 level or above.

European History

A minor in European history consists of 18-24 credits. At least 6 credits must be taken in courses at the 300 level or above. Course work is selected in consultation with the faculty advisor.

History (General History Minor)

A minor in history consists of 18-24 credits. At least 6 credits must be taken in courses at the 300 level or above. Course work is selected in consultation with the faculty advisor.

Political Science

Political science as a minor area of study consists of 18-24 credits of course work. At least 6 credits must be taken in course work at the 300 level or above. Course work is selected by the student in consultation with his advisor. Students who desire to make the most effective use of a minor in political science in pursuing specific career objectives in occupational areas such as (1) law, (2) foreign service, (3) business, management, and public service should consult with the political science faculty in choosing courses which are most appropriate as preparation for such career objectives. The faculty of political science offers several courses in the area of legal-political studies which may be of interest to pre-law students and others.

Social Science

Course work for a minor in social science must be selected from three of the following sub-areas: economics, geography, political science, and sociology. At least 9 credits must be in one area, 6 credits in a second area, and 3 credits in a third area. History concentrators should note that they may not count history courses for the social science minor. Similarly, political science courses may not be counted for the minor by political science concentrators. At least 6 credits must be taken in course work at the 300 level or above.

Interdisciplinary Minors

Students should also check the listing of interdisciplinary minors in the liberal arts which will be found at the end of the College of Liberal Arts section of this bulletin. Interdisciplinary minors offered by other colleges will be found in the program listings of the respective colleges.

History (Course Prefix: 43)

43-101 CLASSICAL CIVILIZATION

The political, social and cultural history of the Graeco-Roman world from the age of heroes to the fall of the Roman empire. (Not open to history concentrators.) Bentas. 3 cr.

43-105 WESTERN CIVILIZATION TO 1715

Traces the major forces in the development of European history from the fall of the Roman empire to 1715. 3 cr.

43-106 WESTERN CIVILIZATION SINCE 1715

Examines the major forces in the development of modern European history from the French Revolution to the present. 3 cr.

43-107 WORLD CIVILIZATION I: ERA OF MIDDLE EASTERN DOMINANCE 8000 BC - 800 AD

A comparative cultural history surveying the course of human civilization in its major world centers up to the time of the collapse of the ancient Mediterrean civilization. P. Blewett. 3 cr.

43-108 WORLD CIVILIZATION II: THE RISE OF THE WEST

A continuation of 43-107, this course traces the decline of the old centers of civilization and the rise of the Atlantic Far West to World dominance. P. Blewett. 3 cr.

43-111 UNITED STATES HISTORY TO 1877

Traces the development of American History and institutions from the colonization to the end of Reconstruction. (Not open to history concentrators.) 3 cr.

43-112 UNITED STATES HISTORY SINCE 1877

Examines significant developments in American History from the end of the Reconstruction period to the present. (Not open to history concentrators.) 3 cr.

43-205 ANCIENT AMERICAN CIVILIZATION

A study of the peoples and civilizations of the Americas from their origins to first contact with Europeans. Luter. 3 cr.

43-206 LATIN AMERICAN CIVILIZATION

An introduction to Latin American history through the study of selected topics from the age of discovery and conquest to the present. Luter. 3 cr.

43-210 HISTORY OF BLACK AFRICA

A general survey of the history of the African continent south of the Sahara, with emphasis on the twentieth century. Luter. 3 cr.

43-213 THE EARLY MIDDLE AGES

A survey of the Latin west and the Greek east during the formative period from the Roman Empire to the creation of the first European civilization. Derry, P. Blewett. 3 cr.

43-214 EUROPE IN THE HIGH MIDDLE AGES

A study of the civilization of the Middle Ages from the 11th to the 14th centuries. The course gives special attention to the relation of the social and economic change, to the development of political, ecclesiastical, and cultural institutions and patterns of thought. Derry. 3 cr.

43-217 RENAISSANCE AND REFORMATION: 1300-1555

An analysis of European civilization from the High Middle Ages to the mid-sixteenth century. The emphasis is on the breakup of the medieval world and the political, cultural, economic and the religious changes associated with the Renaissance and the Reformation eras. P. Blewett. 3 cr.

43-218 EARLY MODERN EUROPE: 1555-1789

This course gives attention to the intellectual and political climate of opinion as well as the social and economic institutions of the Old Regime. P. Blewett. 3 cr.

43-220 EUROPE: 1871-1918

This course looks at Europe at the height of its power and traces the start of its decline. Emphasis is placed on the forces leading up to the cataclysms of World War I and the Russian Revolution. Liebowitz. 3 cr.

43-222 EUROPE IN THE TWENTIETH CENTURY

An examination of selected topics in European history from 1914 to the present: World War I, the Versailles conference, unrest and the collapse of collective security, the rise of Communism, Facism, Nazism, World War II and post war developments. Shea, Liebowitz. 3 cr.

43-225 ANCIENT GREEK HISTORY AND CIVILIZATION

A study of Greek history, institutions and culture from Minoan times through the Hellenistic period. Bentas. 3 cr.

43-226 ROMAN HISTORY AND CIVILIZATION

An analysis of the history, institutions and culture of the Roman Republic and the Empire from earliest times to 330 A.D. Bentas. 3 cr.

43-228 THE AMERICAN INDIAN

A study of native Americans from their first contact with Europeans to the present, with special emphasis on North American Indians and their relationship with the United States government. Luter. 3 cr.

43-230 COLONIAL AMERICA: HISTORY AND CULTURE

Emphasis is on the seventeenth- and early eighteenth-century colonies in British North America and the Caribbean. Topics include: the social, intellectual, and economic development of Virginia and the Puritan colonies, race relations and the origins of slavery, the development of the trans-Atlantic economy, the technology and adaption to the new environment. Carroll. 3 cr.

43-232 THE AMERICAN REVOLUTION

Eighteenth-century America with emphasis on Anglo-American cultural developments, religious change, British colonial policy, revolutionary ideology, and the War for Independence. Carroll. 3 cr.

43-235 CIVIL WAR AND RECONSTRUCTION

Examines the Civil War and Reconstruction in terms not only of events but also of the traditional and revisionist interpretations. Bergeron. 3 cr.

43-237 AMERICAN ENVIRONMENTAL HISTORY

Attitudes, policies and behavior of Americans and their government toward the environment. Special attention to current issues evolving out of our past attitudes and policies. Bergeron. 3 cr.

43-238 HISTORY OF AMERICAN FOREIGN RELATIONS TO 1898

Role of diplomacy in creating the American Republic, establishing its territorial boundaries and strengthening its national power to 1898. Bergeron. 3 cr.

43-239 AMERICAN ECONOMIC HISTORY

A study of the growth and development of the American economy from its European origins to the present. Lipchitz. 3 cr.

43-243 AMERICAN URBAN HISTORY I

An examination of the process of urbanization in America. Topics covered include the origin and development of the American city, ethnic conflict, the political machine, police, and transportation. Walsh. 3 cr.

43-244 AMERICAN URBAN HISTORY II

A continuation of 43-243. Topics include poverty, housing, health delivery, suburbanization, and city planning. Walsh. 3 cr.

43-246 AFRO-AMERICAN HISTORY

The experience of the Blacks in America from the colonial times to the present, including such topics as the African background, slavery in the U.S. and South America, 20th century protests, Afro-American literature, and the problems of the cities. Bakken. 3 cr.

43-248 HISTORY OF JAPAN SINCE 1600

A study of the traditional Japanese institutions and the transformation of Japan into a modern state after 1868; the Tokugawa shogunate, Meiji restoration, Russo-Japanese War, world power status, militarism, World War II, and present day Japan. Shea. 3 cr.

43-253 EUROPEAN SOCIAL AND ECONOMIC HISTORY SINCE THE INDUSTRIAL REVOLUTION

The causes of the industrial revolution and the process of industrialization. Life in the urban, industrial world. New ideologies, new types of social organization, European economic integration. Liebowitz. 3 cr.

43-254 FRANCE SINCE 1814

A consideration of the evolution of France in its broad European setting from the Bourbon restoration through the Fifth Republic. The course examines the interaction of social, economic, political and diplomatic trends, with particular attention to the struggle between the Right and the Left. Shea. 3 cr.

43-255 EARLY MODERN GERMANY

The political and cultural development of the German nation from 1517 to 1789. Topics include the Protestant and Catholic Reformations, the Thirty Years' War, the rise of Brandenburg-Prussia, German Absolutism in the age of Frederick the Great, and the "Enlightenment" of the eighteenth century. Mattheisen. 3 cr.

43-256 NINETEENTH CENTURY GERMANY

From the end of the Holy Roman Empire to the First World War. Deals with the development of revolutionary nationalism, the violent creation of the Bismarckian Empire, and the rise of the Germany to political, military, and industrial preponderance in pre-war Europe. Mattheisen. 3 cr.

43-257 TWENTIETH CENTURY GERMANY

The collapse of the German Empire, the failures of the Weimar Republic and the Third Reich, and the end of German political unity. Some attention will be given to the present-day republics of East and West Germany. Mattheisen. 3 cr.

43-258 HISTORY OF RUSSIA TO 1796

The growth of the Russian state: Varangian origins, the Kievan state conversion to Christianity, Mongol domination, the rise of Muscovy, Europeanization and expansion under Peter the Great and Catherine the Great. Shea. 3 cr.

43-259 HISTORY OF RUSSIA IN THE 19th-20th CENTURIES

Selected topics in modern Russian history: political and social reforms of the nineteenth century, international policies in Europe and Asia, the 1917 revolutions, development of the new regime under Lenin, Stalinist policies, World War II and Russian expansion. Shea. 3 cr.

43-261 GREEK AND ROMAN HISTORIANS

Extensive reading in English translation of important Greek and Roman historians. Historians studied include Herodotus, Thucydides, Xenophon, Livy, Tacitus and Procopius. Bentas. 3 cr.

43-266 HISTORY OF AMERICAN POPULAR CULTURE

An investigation of the social content and institutional character of mass culture in America since 1850. Walsh. 3 cr.

43-268 HISTORY OF THE FAMILY AND CHILDHOOD IN THE UNITED STATES

An analysis of the status of children, the role of the family, and effect of other institutions on children and family throughout American history. Includes historical study of an individual family. Bakken. 3 cr.

43-270 WOMEN IN AMERICAN HISTORY

A study of women as a social group in American history. M. Blewett. 3 cr.

43-274 THE FAMILY IN WESTERN SOCIETY

An analysis of changes in the role of the family in Europe and America. Relations between husbands and wives, parents and children, the family and society as a whole will be covered. Special attention will be given to the impact of modernization and industrialization on the family. Liebowitz. 3 cr.

43-277 ETHNIC GROUPS IN AMERICAN LIFE

An examination of the importance of ethnic groups in American history. The course will treat several major ethnic groups and assimilation or non-assimilation into American life. Field work and research on ethnic groups in the Merrimack Valley. Bakken. 3 cr.

43-280 INTER-AMERICAN RELATIONS

The historical development of relations among the Latin American states and of attitudes and policies between Latin American and the United States from independence to the present time. Luter. 3 cr.

43-282 HISTORY OF TECHNOLOGY

The rise of technology in England, Germany and the United States with emphasis on the mid-19th century to the present, and particularly the electrical industry. The connection among technology, science and society is illustrated through comparative study of such electrical companies as Siemens in Germany with Westinghouse and General Electric in the United States. Miller. 3 cr.

43-284 SCIENCE AND THE MODERN WORLD

A survey of scientific and technological thought from the Babylonians and Egyptians to the present. Emphasis is

on the interplay among science, technology, and society, as well as the organization of science as a discipline. Miller. 3 cr.

43-301 LATE 19th CENTURY UNITED STATES HISTORY

A study of gigantic expansion of American industry after Reconstruction, the social tensions generated by the impact of finance capitalism and the beginnings of reform. Backed by industrial might, the U.S. takes a place among the great powers after the Spanish American War. M. Blewett. 3 cr.

43-302 PROGRESSIVE AMERICA, 1900-1930

In reaction to industrialization and its accompanying changes which produced a crisis in American society in the 1890's, the first three decades of the twentieth century provide the setting for the development of modern American liberalism in domestic and foreign policies. M. Blewett. 3 cr.

43-303 AMERICA BETWEEN THE WARS, 1918-1941

Selected topics in the interwar period, such as U.S. rejection of the League of Nations, the economic, social and political changes of the twenties, the depression and the New Deal and their impact on American life, and America's relationship with the rest of the world that culminated in U.S. involvement in W.W.II. Price. 3 cr.

43-304 RECENT U.S. HISTORY, 1940 TO THE PRESENT

The involvement of the U.S. in World War II marks a major turning point in American History. It ushers in twenty years of Cold War tensions, the militarization of society and participation in foreign alliances and limited wars. Anti-communist conservatives, militant Blacks and a New Left polarize politics and produce a contemporary crisis of confidence in American Society. M. Blewett. 3 cr.

43-306 AMERICAN INTELLECTUAL HISTORY TO 1890

Selected topics in intellectual history from colonial times to the Civil War. Examines the major intellectual currents and the interaction between ideas and social structure. Topics include Puritanism, political philosophy, the pursuit of an American style, slavery and the sectional conflict, transcendentalism and social reform, and Social Darwinism. Bakken. 3 cr.

43-307 MEN, WOMEN AND WORK

A survey of labor history from the colonial period to the present, focusing on the interrelationship between culture and work in American society and on the dynamics of technical and economic changes on the organization of work processes. M. Blewett. 3 cr.

43-308 HISTORY OF CRIME, CONFLICT, AND CONTROL IN THE UNITED STATES

An analysis of the causes and development of attempts to control crime, ethnic conflict, radical and protest movements, urban disorders, and attitude and role conflicts. Walsh. 3 cr.

43-312 MODERN LATIN AMERICA

An analysis of significant trends and problems of Latin America, with emphasis on the economic, political, and social conditions which stimulate or deter progress. Luter. 3 cr.

43-313 AMERICAN SOCIAL HISTORY TO 1880

Selected topics in American social history, including mobility and class structure in American life, American religion, ideals of family life and child rearing, race and ethnic groups in American life, myths and reality in American economic life. Bakken. 3 cr.

43-314 AMERICAN SOCIAL HISTORY SINCE 1880

A continuation of the preceding. Prerequisite of the instructor. Bakken. 3 cr.

43-315 NEW ENGLAND HISTORY

Study of New England as a distinct and unique selection of the U.S. Particular emphasis will be placed on the political history of New England and the contributions of this region to national development. Price. 3 cr.

43-317 THE AMERICAN FRONTIER

Readings and discussion of the history of the American frontier and the place of the frontier in American society and thought. Bergeron. 3 cr.

43-320 YOUNG AMERICA, 1789-1848

This course covers the rise of nationalism, the growth of the American political system, Jeffersonian and Jack-

sonian influences, and the origins of our industrial development. Consideration will also be given to the affects of sectionalism, expansion and the early nineteenth-century reform movements of the values and attitudes of the ordinary American. Bergeron, Price. 3 cr.

43-324 THE RISE OF INDUSTRIAL AMERICA

An interdisciplinary study of the interrelationships among technological, economic, and social, and cultural forces in America from 1775 to 1917. Topics include: the nature of economic growth, changes in the concept and organization of work, abstract and three-dimensional thinking, the nature of invention, the codification and diffusion of technical practices, the development of engineering as a profession, and the emergence of scientific technology. Special emphasis will be given to developments in water and steam power, textiles, iron and steel, electric communications and power, petroleum, and the internal combustion engine. 3 cr.

43-325 NUCLEAR POWER: ITS PAST, PRESENT AND FUTURE

An analysis of the development of nuclear power that includes: the beginning of nuclear physics; the Manhattan Project; the H-bomb; nuclear reactors; the status of nuclear armaments; and the ethical issues involved in this close look among science, technology, society and the military. Miller. 3 cr.

43-330 EUROPEAN URBAN HISTORY

The origins of the city. Changing functions of cities in Ancient, Medieval and Early Modern Europe. The industrial city and the city of the future. Liebowitz. 3 cr.

43-333 HISTORY OF SCIENCE I

The development of astronomy and physics from Plato and Aristotle through Kepler, Galileo and Newton. Miller. 3 cr.

43-334 HISTORY OF SCIENCE II

The development of astronomy, biology, chemistry and physics from the 18th century through the present-day molecular biology, genetics, relativity, quantum theory and cosmology. (NOTE: 43-334 need not be considered a continuation of 43-333, and from time to time these courses will be offered separately.) 3 cr.

43-335 QUANTITATIVE METHODS IN HISTORY AND POLITICAL SCIENCE

The application of statistical methods to problems in history and political science. Students will undertake a series of projects using the computer. The course is open to students from all majors. No previous experience is assumed. Liebowitz. 3 cr.

43-336 RADICALISM IN AMERICAN HISTORY

A biographical approach to the influence of radicalism on American history with emphasis on significant and representative personalities and their contributions Bergeron. 3 cr.

43-342 THE SECOND WORLD WAR

A general survey of the war, together with a closer examination of selected topics. Mattheisen. 3 cr.

43-345 MODERN EUROPEAN IMPERIALISM

Motives, methods and results of imperialism in the nineteenth and twentieth centuries; the partition of Africa and penetration of Asia as contrasting phases in the expansion of Europe. Shea. 3 cr.

43-352 ENGLAND IN THE MIDDLE AGES

The history of the English people and nation from the Roman conquest to the end of the Fourteenth century, with special emphasis on the development of political and social institutions. Derry. 3 cr.

43-353 TUDOR ENGLAND

An intensive study of the social, economic, and constitutional structure of England in the 16th century, which however, begins with a review of the problems of the period 1399-1485. P. Blewett. 3 cr.

43-354 STUART AND AUGUSTAN ENGLAND

A sequel to 43-353 (which is not a prerequisite), this course deals with the great revolution of the 17th century and its aftermath, emerging political stability, down to 1760. P. Blewett. 3 cr.

43-355 THE AGE OF IMPROVEMENT: ENGLAND, 1760-1885

The course s concerned with the industrial revolution and economic, social and political results inherent in it. Particular attention will be paid to the philosophy and the methods of the people at the time to improve themselves and society. Lipchitz. 3 cr.

43-357 ENGLAND SINCE 1885

Discussion will be centered on both domestic and foreign problems, the change in the nature of social reform after the turn of the century, and the dramatic dissolution of the Empire. Lipchitz. 3 cr.

43-358 PROBLEMS OF MODERN IRELAND

Study and discussion of problems of twentieth-century Ireland set in their historical perspective. Lipchitz. 3 cr.

43-359 BRITAIN AND THE EMPIRE

Against a background of social, economic and political changes, the course will emphasize British foreign policy and the development of the empire from the war with Napoleonic France to the twentieth century when the empire evolved into the British Commonwealth. Lipchitz. 3 cr.

43-360 BYZANTINE HISTORY AND CIVILIZATION

A study of the important political, social and cultural changes in the East Roman Empire from the founding of Constantinople to the fall of the Empire in 1453, with emphasis on the role of Byzantium as the custodian of the classical past. Bentas. 3 cr.

43-362 THE FRENCH REVOLUTION AND NAPOLEON

A close analysis of French society from 1600-1815 which attempts to understand the cause of the French Revolution and its aftermath. P. Blewett. 3 cr.

43-364 HISTORY OF SOCIALISM

The growth of the socialist movement from the utopian socialist thinkers of the early 19th century through the socialist, anarchist, and communist mass-movement of the 20th century. Mattheisen. 3 cr.

43-366 COLONIALISM AND THE THIRD WORLD

Non-western societies before the European arrival; the impact of colonialism; revolts for independence and the creation of a new economic and political order; emphasis will be placed on Africa, India and China. Liebowitz. 3 cr.

43-367 AMERICAN INDIANS IN THE TWENTIETH CENTURY

A study of the problems of American Indians today. Luter. 3 cr.

43-370 INTRODUCTION TO HISTORICAL METHOD

An introduction for the undergraduate student to the nature and principles of history. The course takes up methodology, historiography, research methods, bibliography and the technical and stylistic problems involved in the presentation of research in scholarly form. Required of all history majors in sophomore year. Non-majors are admitted with permission of the instructor. Derry. 3 cr.

43-432 RESEARCH SEMINAR IN HISTORY

An original investigation in primary sources, culminating in the writing of a major paper based on systematic research and methodological techniques. Weekly meetings and reports. Prerequisites: 43-370 and permission of instructor. Required for all senior history majors. 3 cr.

Directed Studies

Directed Study courses are available only to history majors and may be selected provided that (1) the material to be covered is not available in any course to be offered in the semester in which the directed study is to be taken, (2) instructors are willing to undertake a directed study course, and (3) no more than 9 credits in the major field are earned in directed study courses.

43-491 DIRECTED STUDY IN HISTORY

Directed study offers the student the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, the student will define and investigate a research problem in an area of special interest and present the results of his investigation in a significant paper. Junior and seniors. Prerequisite: Permission of instructor and chairperson. 3 cr.

43-495 ADVANCED TUTORIAL IN HISTORY

A program of directed study in which the student through regular consultation with the instructor develops an evaluative and critical essay. The purpose is to sharpen and refine techniques for scholarly research in the stu-

dent's major discipline. Prerequisite: Demonstrated proficiency in an area selected for directed study and permission of instructor and chairperson. 3 cr.

Practicum

43-496 PRACTICUM EXPERIENCE

A program of campus and off-campus experiences for history majors only. Specific requirements will vary, depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated to a maximum of 9 credits. Students will be graded "satisfactory" or "unsatisfactory". The practicum experience may not be substituted by a required course in the major. Prerequisite: permission by Department Chairperson. 3 cr.

Cross-Referenced Courses

Special reference is made to the following courses, which may be credited to history programs: 46-344: The American Presidency; 46-345: Judicial Review and Constitutional Development; 46-380: Contemporary American Foreign Policy; and 46-368: The Middle East and the Modern World.

Political Science (Course Prefix: 46)

46-101 INTRODUCTION TO AMERICAN POLITICS

An introductory exploration of basic political concepts and themes, emphasizing the politics, structure and behavior of the American national political community. 3 cr.

46-112 COMPARATIVE POLITICAL SYSTEMS

A cross-cultural analysis of various governmental systems, ranging from tribal governments in less developed systems to modern national governments. Elements common to all forms of government are emphasized and variations among contemporary political systems are discussed. Nowlin. 3 cr.

46-121 INTRODUCTION TO INTERNATIONAL RELATIONS

A survey of some recent methods and approaches used in the study of international politics and the introduction of current problems of foreign policies of major world powers. Pho. 3 cr.

46-200 INTRODUCTION TO POLITICAL THOUGHT

An examination of the concepts, ideas, theories and ideologies of politics—ancient and modern and across cultures. 3 cr.

46-201 POLITICAL ANALYSIS

Introduces the Political Science major to the scope of politics as a discipline. Examines the principal approaches, methods, tools and techniques used in the study and analysis of political behavior and institutions. Examples from the literature of the discipline will be utilized. Minton. 3 cr.

46-202 PRACTICAL PUBLIC AFFAIRS

Designed to equip the major and others with academic research and operational skills useful in entry level jobs in the public affairs area. Covers subjects such as legislative, administrative and legal research; filing requirements; budgets; elementary computer and statistical techniques; grant writing; polling; fundraising; voter organization; and constituent services. 3 cr.

46-206 CURRENT POLITICAL ISSUES

Analysis of the constitutional, socio-demographic, and political background of selected contemporary public issues and policies. Minton. 3 cr.

43-207 AMERICAN ENVIRONMENTAL HISTORY AND POLITICS

Attitudes, policies, and behavior of Americans and their government toward the environment. Special attention to current issues evolving out of our past attitudes and policies. Bergeron. 3 cr.

46-211 COMPARATIVE EUROPEAN POLITICS

An analytical examination of selected modern European political systems, emphasizing similarities and differences in political culture, political behavior, political institutions, and political performance. Minton. 3 cr.

46-214 POLITICS OF THE THIRD WORLD

Introductory survey of selected third world countries facing intensive problems of economic, social, and political development. Emphasis on the theories of nationalism and political development. Pho. 3 cr.

46-216 SOUTHEAST ASIAN POLITICS

Survey of Southeast Asian countries including Indonesia, Thailand and Vietnam. Review of the anti-colonial struggles and examination of the patterns of nation-building during the recent, post-colonial period. Pho. 3 cr.

46-230 LAW AND THE LEGAL SYSTEM

An introduction to the nature of the legal process and the operation of the American Legal System; consideration of its political and social functions. Lewis. 3 cr.

46-238 AMERICAN POLITICAL THOUGHT

A survey of American political thought with emphasis upon selected thinkers and their contributions to the development of concepts and ideas basic to the American political culture. Among thinkers considered are Paine, Jefferson, Madison, Hamilton, Emerson, Brownson, Calhoun, Fitzhugh, Sumner, Bellamy, Croly, Dewey, Dahl and Marcuse. Denning. 3 cr.

46-250 WOMEN, POWER, AND POLITICS

An analysis of the relationship of women to power and politics especially as shown in the contemporary women's movement. Rothschild. 3 cr.

46-260 PUBLIC ADMINISTRATION

An introductory study of bureaucratic organization and behavior in American society. 3 cr.

46-265 STATE AND LOCAL GOVERNMENT

An exploration of the federal relationship through study of politics and government at the state and local levels. 3 cr.

46-270 LEGISLATIVE POLITICS

A comparative study of the legislative process and the law-making function focusing upon the Congress, the Massachusetts state legislature and other legislative bodies. 3 cr.

46-282 CONTEMPORARY POLITICAL THEORY

An examination of major ideological currents in the contemporary world. Possible topics include Marxism, communism, fascism, anarchism and the relevance of Freud to modern political thought. Denning, Nowlin. 3 cr.

46-309 POLITICAL SOCIALIZATION IN AMERICA

An in-depth examination of the acquisition of political attitudes and values within the American political system with special emphasis upon the relationship between human rights and "schooling" for citizenship. Attention is also given to the family, peer groups, media, and elites as socializing agents for both stability and change. Denning. 3 cr.

46-311 POLITICAL OBLIGATION

An analysis of selected classical and modern theories of obligation, including consensual, organic, prescriptive, and utilitarian models. Also examined are related problems and topics such as legitimacy, authority, justice, freedom, order, change, violence, and civil disobedience. Consideration is given to the similarities and difference among political, legal, and moral obligations. Denning. 3 cr.

46-324 POLITICAL BEHAVIOR

Designed to give the student information about the nature of political behavior, especially American political behavior. Will include examination of the literature on such topics as political attitudes, political socialization, party behavior, institutional relationships, voting behavior, protest and support behavior. Students will be given the opportunity to research and to analyze some aspect of political behavior. Minton. 3 cr.

46-325 ELECTORAL POLITICS

A study of voting behavior, voting patterns and critical elections with attention to causes, fluctuations and current trends. 3 cr.

46-330 POLITICAL, SOCIAL, AND TECHNOLOGICAL ALTERNATIVES

An examination of alternatives to the organization of Western technological society, to include study of the values, and the political, social, and technological aspects of the alternatives analyzed. Rothschild. 3 cr.

46-336 RADICALISM IN AMERICAN SOCIETY

An examination of the influence of radicalism upon American political and social development with emphasis on significant personalities and their contributions. Bergeron. 3 cr.

46-342 PARTIES, POLITICS AND INTEREST GROUPS

Origins, characteristics and functions of American political parties and interest groups with consideration of other forms of political participation such as demonstrations, non-violent protests and confrontation politics. Bergeron. 3 cr.

46-343 THE CONGRESS

An advanced study of the functioning of the American national Congress within the American political system. 3 cr.

46-344 THE AMERICAN PRESIDENCY

An examination of the nature of the American Presidency and its functioning within the American political system. Specific attention will be given to problems and the evolution of the Presidency since World War I. Minton. 3 cr.

46-345 CONSTITUTIONAL LAW AND POLITICS

An advanced study of judicial review and judicial behavior as they have developed through the historical process of constitutional adjudication. Special emphasis given to the continuing tension between judicial review and American democracy. Lewis. 3 cr.

46-347 CIVIL LIBERTIES, LAW, AND POLITICS

An advanced examination of the development of American concepts of civil liberty and equal rights through the historical process of constitutional adjudication, and in other areas of law, government and society. Lewis. 3 cr.

46-350 URBAN AND METROPOLITAN POLITICS

A behavioral study of the political structures of urban areas and the major issues currently confronting them. Bergeron. 3 cr.

46-355 GOVERNMENT FISCAL POLICY

A review of government fiscal policy, procedures and techniques. Analysis of budget cycles, controls and decision-making processes and their impact upon public program planning and implementation. 3 cr.

46-356 PUBLIC POLICY ANALYSIS

The application of analytical techniques to the evaluation of governmental policy options. 3 cr.

46-357 ADMINISTRATIVE LAW AND POLITICS

A study of the nature of administrative regulation; includes presentation of basic administrative law doctrines. Lewis. 3 cr.

46-358 ADMINISTRATIVE BEHAVIOR AND THEORY

An advanced comparison of the theory of public administration with its practice. 3 cr.

46-363 POLITICS OF COMMUNIST CHINA

A study of the recent development of governmental institutions, parties, and ideology in Communist China. Emphasis is placed on the processes of nation-building in the post-World War II period. Pho. 3 cr.

46-365 SOVIET POLITICS

An examination of the relationship of politics to the functioning of Soviet society. The influence of politics upon the economy, education, family life, religion, etc. Minton. 3 cr.

46-368 THE MIDDLE EAST AND THE MODERN WORLD

An appreciation of Middle Eastern attitudes and values will be utilized in developing insight into the cultural tensions that exist between the Middle East and the Western World. Political, financial and foreign policy problems will be emphasized with attention given to their relationship both to the United States business community and to the international business community. Bergeron. 3 cr.

46-371 COMPARATIVE CARIBBEAN POLITICS

A comparative study of the political, social, cultural and economic forces that have led to the current turmoil in the countries of the Caribbean areas. 3 cr.

46-380 CONTEMPORARY AMERICAN FOREIGN POLICY

A study of the processes of American foreign policy in the contemporary world. The case study method will be used to illustrate problems of strategy and tactics in such areas as Europe, Latin America, Africa, and the Near and Far East. Bergeron. 3 cr.

46-382 U.S. FOREIGN POLICY IN INDOCHINA

A study of the international developments resulting in U.S. involvement in Indochina after World War II. Emphasis placed on the U.S. role in the 2nd Indochina War and the intensive domestic and international repercussions. Pho. 3 cr.

46-384 CHINESE FOREIGN POLICY

Review of international politics and the development of recent Chinese diplomacy. Examination of elements of Chinese national power and weaknesses. Emphasis on diverse pursuit for the realization of Chinese goals including China's reliance on foreign trade to achieve her foreign policy objectives. Pho. 3 cr.

46-390 DEFENSE AND DISARMAMENT

An advanced study of the international security policies currently pursued by the United States, its allies and its adversaries; evaluation and analysis of the criticism of these policies and of the possibilities of achieving disarmament. 3 cr.

Seminars

46-402 through 46-420 READING SEMINARS IN POLITICS

Advanced reading, discussion analysis and research in selected areas of political study. 3 cr.

46-432 RESEARCH SEMINAR IN POLITICS

Original investigation in primary sources and secondary literature culminating in the writing of a major paper based on systematic research and methodological techniques. Weekly meetings and reports. Prerequisites: 46-201 and permission of instructor. Required course for senior political science majors. 3 cr.

Directed Studies

Directed study courses are available only to political science majors and may be elected provided that (1) the material to be covered is not available in any course to be offered in the semester in which the directed study is taken, (2) instructors are willing to undertake a directed study course, and (3) no more than nine credits in the major field are earned in directed study courses.

46-491 DIRECTED STUDY IN POLITICAL SCIENCE

Directed study offers the student the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, the student will define and investigate a research problem in an area of special interest and present the results of his investigation in a significant paper. Juniors and seniors. Prerequisites: Permission of instructor or chairperson. 3 cr.

46-495 ADVANCED TUTORIAL IN POLITICS

A program of directed study in which the advanced student develops an evaluative and critical essay. The purpose is to sharpen and refine techniques for scholarly research and presentation. This course may not be offered in place of the required seminar course. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of the political science faculty and chairperson. 3 cr.

Practica

46-496 PRACTICUM EXPERIENCE

A program of study and research (for political science majors only) stressing involvement in and first-hand knowledge and observation of the political life and relationships of national state and local institutions. The pur-

pose is to acquaint the student in a direct way with the actual operation of political institutions and the behavior of political actors. Specific requirements will vary depending upon the nature of the program undertaken by the student. Required of all political science majors with the exception of those accepted in teacher-education programs. May be repeated to a maximum of 9 credits. Students will be graded "satisfactory" or "unsatisfactory". 3 cr.

46-497 PRACTICUM IN THE LAW

A variation of 46-496 offering involvement and first-hand knowledge and observation of the legal system and legal practice. 3 cr.

Cross-Referenced Courses

Special reference is made to the following courses that may be credited to the political science minor and the political science major: 43-335-Quantitative Methods in History and Politics.

Administration of Law & Justice-Criminal Justice

(Course Prefix: 44)

44-101 THE CRIMINAL JUSTICE SYSTEM

The course includes a brief history of the Criminal Justice System and an analysis of its structure and function. Required for all majors and prerequisite to all courses in Criminal Justice. Prerequisite to all other courses in program. 3 cr.

44-131 PRINCIPLES OF LAW AND THE CRIMINAL JUSTICE SYSTEM

Basic principles of law and the working of the legal system are discussed as they pertain to the criminal justice professional. There will be particular emphasis on legal reasoning and analysis. Co-requisite: 44-101. 3 cr.

44-141 POLICE FUNCTIONS: THEORY AND APPLICATION

An examination of the historical development of police work with special emphasis on the conflicting role expectations facing the police officer. 3 cr.

44-151 INTRODUCTION TO CORRECTIONS I

A comprehensive view of theory, practice and philosophy involved in the treatment of convicted law violators of all ages. 3 cr.

44-221 CRIMINOLOGY I

The definition and nature of crime, criminal statistics, and a survey of theories of crime causation will be included. Required for all majors. 3 cr.

44-234 CRIMINAL LAW

The historical origins and development of criminal law from the early common law to contemporary decisions and statutes. Constitutional and statutory factors as they pertain to crime, defense, and crimes against persons and property will be considered. In addition attention is directed toward limitations of criminal responsibility, capacity and the law of arrest. Sections of the Massachusetts Criminal Code and other statutes will be covered where applicable. Prerequisite: 44-131. 3 cr.

44-243 CRIMINALISTICS I

Basic procedures in arrest, search and seizure, and the gathering as well as the evaluation of evidence as to admissibility, weight, and competence. Prerequisite: 2 semesters of science. 3 cr.

44-244 CRIMINALISTICS II

Collection, identification, preservation, and transportation of physical evidence. The crime laboratory and its effectiveness, capabilities and limitations in assisting the police officer in utilizing physical evidence as a means of apprehension and/or conviction. Prerequisite: 44-243. 3 cr.

44-261 JUVENILE DELINQUENCY

Causative factors in the development of youthful offenders will be examined. The development and philosophy behind treatment of juvenile court and clinic, training schools, and contemporary innovative practices will be covered. 3 cr.

44-321 CRIMINOLOGY II

An examination of theories of criminal behavior, both historical and contemporary, and their impact on the evolution of punishment, treatment and rehabilitative practices. Prerequisite: 44-221. 3 cr.

44-331 PENAL LAW

A study of the constitutional rights of incarcerated individuals, including major policy issues and trends associated with recent revisions of penal codes reflecting court decisions for the preservation of offenders' rights. Prerequisite: 44-234. 3 cr.

44-335 JUVENILE COURT PHILOSOPHY AND PRACTICE

Examination of the civil procedures used in the juvenile court as opposed to the adversary procedures used in criminal court, together with a history of the development of the juvenile court and an examination of its constitutional basis. Prerequisite: 44-261. 3 cr.

44-341 COMPARATIVE POLICE SYSTEMS

A study of various police systems on the national and international level and a comparison with local systems of the basis of organization, structure, and administration of law enforcement agencies. Agencies in Europe, United Kingdom, Russia, and other parts of the United States will be reviewed. 3 cr.

44-351 ALTERNATIVES TO CORRECTIONS I

Modern trends in corrections, such as the community based programs in work-release, half-way houses, parole clinics, the therapeutic community, and team treatment concept in institutions are evaluated. Prerequisite: 44-151. 3 cr.

44-354 PROBATION AND PAROLE

The historical development of both probation and parole, and an examination of their place in the criminal justice system. There will be an emphasis on recent trends including diversion, flat sentencing, weekend sentencing, and the problems resulting from departure from traditional practices. 3 cr.

44-360 MINORITIES AND THE CRIMINAL JUSTICE SYSTEM

Both social and legal consequences of racism and discrimination will be discussed as they pertain to minorities and the criminal justice system. Because of the necessary reliance on some legal knowledge and legal reasoning the following prerequisites are demanded: 44-234 Criminal Law and 46-205 Constitutional Law and Civil Liberties or 46-206 Constitutional Law and Civil Rights. 3 cr.

44-371 CRIMINAL JUSTICE, MANAGEMENT AND PLANNING

An introduction to the principles of administration, including planning, budgeting, grantsmanship and evaluation, as they relate to the criminal justice manager. 3 cr.

44-372 ISSUES IN CORRECTIONAL ADMINISTRATION

Specific analysis of the management of correctional institutions, including custody, classification, reception, programming, release, staffing, scheduling, collective bargaining, and other related issues. Prerequisite: 44-371. 3 cr.

44-373 ISSUES IN POLICE ADMINISTRATION

Specific analysis of the management of contemporary police force, including staffing, scheduling, training, collective bargaining, community relations and other related issues. Prerequisite: 44-371. 3 cr.

44-380 SELECTED TOPICS IN CRIMINAL JUSTICE

Topics chosen from current issues and problems in criminal justice. Subjects taken up in the course will vary but will include such questions as victimology, social and psychological aspects of crime, crime control and deterrence, evaluation and policy research. 3 cr.

44-390 RESEARCH METHODS IN CRIMINAL JUSTICE

An introduction to methods in criminal justice research, including research design, terminology, standard methodologies, and elementary statistics. Required for all majors. 3 cr.

Seminars

44-401 SEMINAR ON DRUGS

The course is designed to cover the problems of drugs, drug abuse, drug law and its application. Treatment of and

alternatives to drug rehabilitation will be studied in addition to the classification, identification, distribution, and control of drugs. 3 cr.

44-406 SENIOR HONORS PROJECT

44-490 RESEARCH SEMINAR IN CRIMINAL JUSTICE

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Specific practice in the definition, design and execution of a research project, and an analysis of the impact of contemporary criminal justice research on policy development. Prerequisite: 44-390. Required for all majors. 3 cr.

Directed Studies

Directed study courses are available only to majors in the administration of law and justice (criminal justice) and may be elected provided that (1) the material to be covered is not available in any course offered during the semester in which a directed study course is contemplated, (2) instructors are willing to undertake a directed study course, and (3) no more than 9 credits in the major field are earned in directed study courses.

44-491 DIRECTED STUDY IN CRIMINAL JUSTICE

Directed study offers the student the opportunity to engage in an independent study or research project under the supervision of a department member. The student, working closely with the instructor, will define and investigate a research problem in a special area of interest and present the results of his investigation in a significant paper.

3 cr.

Practicum

44-496 PRACTICUM-FIELD EXPERIENCE

Assigned field work under the supervision of a member of the department. Normally taken in the senior year, the practicum course is designed to provide pre-service students in criminal justice the opportunity to apply skills and techniques in selected correctional, law enforcement, probation and parole agencies within the area. The field experience aims at combining practical experience with theoretical knowledge in the student's area of interest. Required for all majors. 3 cr.

Cross-Referenced Courses

Special reference is made to 46-131: Introduction to Law and the Legal System, which may be credited to Administration of Law and Justice (Criminal Justice) programs.

DEPARTMENT OF LANGUAGES

Chairperson, Professor Mario Aste

Professors: Mario Aste, Joseph Garreau

Associate Professors: Robert Bousquet, Pilar Concejo, Heji Hernandez, John Mendicoa

Assistant Professors: William Mulcahy, Herlinda Saitz, Robert Whelan

The Department of Languages offers majors in French, Modern Languages, and Spanish leading to the Bachelor of Arts degree. Also offered are minors in French, German studies, Greek, Italian studies, Spanish, and (in cooperation with other departments) classical civilization, and Latin American studies. Especially attractive is the track in Communication (French, Modern Languages and Spanish) leading to a Bachelor of Arts degree emphasizing the technical and business aspects of the language major.

Major Requirements

French Major

The French major provides a broad liberal arts education for students interested in developing a proficiency in the French language, a general knowledge of the cultural and literary heritage of French civilization and a basic insight

into the function of verbal symbols in the process of human thought. This concentration provides students with sufficient preparation for a career in language teaching or bilingual education or for business or social-service careers requiring a command of the French language. A student may combine the French concentration with other supporting studies, thus tailoring an undergraduate program to meet his individual career objectives. Especially attractive options are French and business management or French and engineering.

Major Requirements

A major in French consists of 30-45 credits (with at least 15 credits at the 300 course level or above) and normally will include a combination of 18 credits in language and 12 in literature courses. Language courses will normally comprise the following core:

50-221	Reading and Conversing in French I	3
50-222	Reading and Conversing in French II	3
50-244	Advanced French Grammar and Syntax	3
50-246	Advanced French Conversation	3
50-348	Advanced French Composition	3

Additional course work beyond the prescribed courses may be elected from the French offerings of the Department to a maximum of 45 credits.

Students transferring to the College who wish to major in French must make individual arrangements with the Chairperson of the Department regarding satisfaction of major and collateral course requirements.

Modern Languages Major

The major in modern languages provides varied options for students who are interested in languages, not only from the viewpoint of a possible marketable skill, but also as a means of communication with people who speak a language which is different from their own.

A student may combine the modern Language concentration with other supporting studies and may tailor his or her undergraduate program to meet individual career objectives. Especially attractive are combinations with other majors in the College of Liberal Arts and other combinations with Business management and Engineering.

Major Requirements

The modern language major consists of 36-45 credits above the 100 course level (with at least 15 credits at the 300 course level or above) and includes the following option:

Option I (French and Spanish)

Typically, the student earns 24 credits in one language and 12 credits in the other. He or she may also elect a program with 18 credits in each language.

Students who transfer to the College and who wish to major in modern languages must make individual arrangements with the Chairperson regarding satisfaction of major requirements.

Spanish Major

A major in Spanish provides a broad liberal arts education for students who are interested in developing a proficiency in the Spanish language, a broad knowledge of the cultural and literary heritage of Spanish and Latin American civilization, and a basic insight into the function of verbal symbols in the process of human thought. This major provides students with sufficient preparation for a career in language teaching and bi-lingual education and for business and social services careers requiring a command of the Spanish language. A student may combine the Spanish concentration with other supporting studies and may tailor his undergraduate program to meet his individual career objectives. Especially attractive options are (1) Spanish and sociology for students who wish public service in government agencies. (2) Spanish and Business management or Spanish and engineering.

The major in Spanish consists of 33-45 credits (with at least 15 credits at the 300 level or above) and normally will include 18 credits in language courses and 15 credits in literature courses.

Language Courses*

- 54-231 Spanish Oral Expression I
- 54-232 Spanish Oral Expression II and must include
- 54-245 Advanced Spanish Conversation
- 54-347 Advanced Spanish Composition Electives

*In special circumstances 3 credits in 54-221, 222, Reading and Conversation in Spanish II may be counted as part of the above 18 credits with the permission of the Chairman of the Department. In exceptional cases, 6 credits in 54-313: Fieldwork in the Spanish Community, may be counted as part of the 18 credits of language courses with the approval of the Department Chairperson.

Additional course work beyond the prescribed courses may be elected from the Spanish offerings of the Department to a maximum of 45 credits.

Students transferring to the College of Liberal Arts who wish to major in Spanish must make individual arrangements with the Department Chairperson regarding satisfaction of major and collateral course requirements.

Concentration in Communication

Majors in French, Modern Languages, or Spanish may elect an optional concentration in communication. The concentration emphasizes technical and business writing and includes basic business courses.

Language Requirement

French and Spanish majors must present a minimum of 18 credits in language courses, 12 credits in literature courses. Modern language majors may select two languages combinations as their major with the following options as minimums:

- 18 credits in 1st language courses

- 18 credits in 2nd language courses

- or

- 12 credits in 1st language courses

- 24 credits in 2nd language courses

All course work for the majors must be taken in courses at the 200 level or above.

All concentrators must take:

Seminar in translation (in the appropriate language), plus

- 54-50-372 Applied Linguistics, plus

- 42-224 Business Writing, or

- 42-225 Technical and Scientific Writing, or

- 42-306 Professional Writing, plus

- 92-209 Introduction to Computer Programming

Concentrators will complete four additional courses from those listed below:

- 42-499 English as a Second Language

- 66-200 The Business System

- 42-226 Oral Business Communication

- 66-321 Marketing Principles

- 66-353 Organizational Behavior (Prereq. 47-101, 48-101)

- 57-267 Graphics

- 66-324 Industrial Marketing (Prereq. 66-321)

- 66-102 International Business (Prereq. 66-321, 64-202)

- 92-219 Elementary Computer Programming (Prereq. 92-209)

Minor Requirements

French

A minor area of study consists of 18-24 credits, with at least 6 credits at the 300 or 400 levels. Beginning courses in French at the 100 level may not be credited to the French minor.

German Studies

The interdisciplinary minor in German Studies consists of 18-24 credits of course work. Six credits at the 200 level or above are required for the German language component. Additional courses to complete the required credits may be selected from the following list:

- 58-323 Northern Renaissance Art

- 43-217 Renaissance and Reformation

- 43-222 Europe in the 20th Century

- 43-255 Early Modern Germany

- 43-256 19th Century Germany

- 43-257 20th Century Germany

- 45-401 Hegel and German Idealism

- 59-320 Northern Baroque Culture

At least six credits must be taken in course work at the 300 level or above. Beginning courses in German at the 100 level may not be credited to the German minor.

The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the chairperson of the language department to see which courses are currently approved.

Greek

A minor area of studies in Greek consists of 18 semester credits of course work and must include the following: 53-101-102: Beginning Greek, 53-301-302: Greek Classics, and 53-303-304: Selected Greek Authors, Unlike other modern languages, Greek has enjoyed a continuous tradition since antiquity and no break, such as that between Latin and the Romance languages, separates the language of the ancients from the moderns. Educated Greek speakers have always had present in their minds the whole of the language up to their own time. Hence courses for the Greek minor include literature from all periods—from Homer and Plato to Kazantzakis.

Italian Studies

The interdisciplinary minor in Italian Studies consists of 18-24 credits of course work. Six credits at the 200 level or above are required for the Italian language component. Additional courses to complete the required credits may be selected from the following list:

- 43-213 Renaissance and Reformation
- 43-277 Ethnic Groups in American Life
- 52-371 Dante's Divine Comedy
- 52-373 Petrarch and Boccaccio: A Study in Humanism
- 52-376 Pirandello: Theater and Influence
- 52-378 20th Century Italian Literature Moravia to Fellini
- 58-321 Italian Renaissance Art
- 58-322 Baroque Art in Italy

At least six credits must be taken in course work at the 300 level or above.

Beginning Italian courses at the 100 level may not be credited to the Italian minor.

The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the chairperson of the language department to see which courses are currently approved.

Spanish

A minor in Spanish consists of 18-24 credits with at least 6 credits at the 300 or 400 levels. Beginning courses in Spanish at the 100 level may not be credited to the Spanish minor. Students who are interested in the application of Spanish to the health professions should take 54-313: Fieldwork in the Spanish Community.

French (Course Prefix: 50)

50-101 BEGINNING FRENCH I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of French at the secondary level are ineligible for this course. 3 cr.

50-102 BEGINNING FRENCH II*

A continuation of 50-101, which is a prerequisite.

50-114 FRENCH FOR BUSINESS AND INTERNATIONAL MANAGEMENT II

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A continuation of 50-101 with a reading emphasis, presenting to Business and Management sciences concentrators and others by means of a cultural comparison between the French and American peoples the terminology and practices of the Francophone business world particularly in the domains of Accounting, Banking, management and legal organization. 3 cr.

*Beginning and intermediate language courses at the 101-102 and 211-212 levels must be elected for two consecutive semesters and in the prescribed sequences. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.

50-211 INTERMEDIATE CONVERSATIONAL FRENCH I*

Review of basic grammatical structures and idiomatic patterns with emphasis upon increased proficiency in oral expression and aural comprehension. This course is intended for students who have completed two years of high school French, preferably during their junior and senior years, for students who have completed 50-102, and/or for students who are unqualified for the 221-222 sequence. 3 cr.

50-212 INTERMEDIATE CONVERSATIONAL FRENCH II*

A continuation of 50-211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. 3 cr.

50-221 READING AND CONVERSING IN FRENCH I

The emphasis of this course is upon development and conversational skills, selected contemporary works provide the basis for developing conversational comprehension and composition skills. This course is intended for students with a solid foundation in the French language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 cr.

50-222 READING AND CONVERSING IN FRENCH II

A continuation of 50-221, which is a prerequisite, with emphasis upon continued development of reading and conversational skills. 3 cr.

50-244 ADVANCED FRENCH GRAMMAR & SYNTAX

A systematic study of grammatical and syntactical structures. Review of more advanced problems. 3 cr.

50-246 ADVANCED FRENCH CONVERSATION

Advanced oral practice in rapid and idiomatic speech. Topics of contemporary significance will be selected from contemporary prose. 3 cr.

50-301 SURVEY OF FRENCH LITERATURE I

A survey of French Literature based on the history and civilization of France from the Middle Ages to 1800. 3 cr.

50-302 SURVEY OF FRENCH LITERATURE II

A survey of French Literature based on the history and civilization of France from 1800 to the Present. 3 cr.

50-320 SPECIAL TOPICS IN FRENCH STUDIES

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in French. Course content and approach will vary, depending on instructor. The department will post and distribute detailed course descriptions each semester, and students are urged to use this information in making their selections. 3 cr.

50-348 ADVANCED FRENCH COMPOSITION

Designed to impart proficiency in written French through regular exercises in free composition; analysis of literary texts. 3 cr.

50-372 APPLIED LINGUISTICS

Linguistic analysis of French phonology, morphology, and syntax, with a systematic comparison of the structures of French and English. Required for prospective teachers of French in the elementary and secondary schools. Bousquet. 3 cr.

50-401 SELECTED AUTHORS

An intensive study of works by a few French authors. 3 cr.

50-422 THEATRE AND ANTI-THEATRE

The 20th century French theatre considered as an experimentation in new dramatic forms and as a metaphorical expression of a new vision of life. Plays from major writers (Caudel, Giraudoux, Anouilh, Sartre, Camus, Beckett, Genet, and Ionesco) will be analyzed. Conducted in French. Prerequisite: permission of instructor. 3 cr.

50-432 THE NOUVEAU ROMAN

An examination of the techniques and procedures of French literature of the 50's and 60's with particular reference to Beckett, Butor, Robbe-Grillet, Sarraute, and Simon. Conducted in French. Prerequisite: permission of instructor. Bousquet. 3 cr.

50-454 TECHNIQUES OF LITERARY ANALYSIS

Thematic and linguistic analysis of major French prose and poetry of the 19th and 20th centuries. Prerequisite:

French concentrators with junior or senior status and others with permission of instructor. Conducted in French. 3 cr.

50-456 FRENCH TRANSLATION SEMINAR

A study of the theory and practice of translation, aimed at developing translation skills. Material used is taken from literary works, as well as newspapers and magazines. This course is intended for students with a good command of the language. Open to French concentrators and others by permission of instructor. 3 cr.

50-462 FRENCH MUSIC AND MUSICIANS

French music and musicians from Lully to the present. Conducted in French, with discussions based on readings and recorded music. Prerequisite: French concentrators with junior or senior status and others with permission of instructor. Bousquet. 3 cr.

THE FOLLOWING COURSES ARE CONDUCTED IN ENGLISH AND DO NOT SATISFY ANY LANGUAGE REQUIREMENT AND CANNOT BE COUNTED AS PART OF THE FRENCH MAJOR OR THE MODERN LANGUAGE MAJOR

50-261 LITERATURE OF IDEAS IN FRANCE

Trends of thought in contemporary France, traced back through the centuries to great French writers (Montaigne, Pascal, Voltaire, Diderot). Conducted in English with readings in English translation. May be taken by French concentrators, but may not be credited to the major. 3 cr.

50-263 THE BATTLE OF THE SEXES IN FRENCH LITERATURE

The evolution of the theme from Middle Ages to the present with special emphasis on medieval misogyny, courtly love, preciosity, modern sexual equality and the androgynous figure. 3 cr.

50-271 LOVE, MYTHS, AND REPRESENTATIONS

The theme of love studied in the great Western myths and its representations in literature (Stendhal, Laclos, Aragon/Elsa Triolet and Sartre/Simone de Beauvoir) and in films (Bergman, Truffaut, Godard and Lelouch). Conducted in English with readings in translation. May be taken by French concentrators but may not be credited to the major. 3 cr.

50-377 CLASSICISM AND REALISM: LITERATURE OF FRANCE, ITALY, AND SPAIN

Consideration of major works and authors of French Classicism and Realism. Relationships with counterparts in Italy and Spain will also be treated. Conducted in English. 3 cr.

Directed Studies

Directed Studies are available only to French or modern language majors and may be elected provided that (1) the material to be covered is not available in any French course offered during the semester in which directed studies is contemplated (2) instructors are willing to undertake a directed studies, and (3) no more than 9 credits in the major field are acquired in directed studies courses. 3 cr.

50-491 DIRECTED STUDY IN FRENCH LITERATURE

Individual research projects in French literature. The student through regular and frequent consultation with his instructor develops a course of directed study in French literature and defines a problem for individual research. The students's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor. 3 cr.

50-492 DIRECTED STUDY IN COMPOSITION

The student through regular and frequent consultation with his instructor pursues a special problem of composition or creative expression. Prerequisite: permission of instructor. 3 cr.

50-495 ADVANCED TUTORIAL IN FRENCH

A program of directed studies which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation and for creative expression. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

Practicum

50-496 PRACTICUM EXPERIENCE

A program of campus and/or off-campus experiences (for French and modern language majors only). Specific requirements will vary, depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation for a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated to a maximum of 9 credits. Students will be graded "satisfactory" or "unsatisfactory". The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. 3 cr.

German (Course Prefix: 51)

51-101 BEGINNING GERMAN I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of German at the secondary level are ineligible for this course.

51-102 BEGINNING GERMAN II*

A continuation of 51-101, which is a prerequisite. 3 cr.

51-113 ELEMENTARY TECHNICAL GERMAN I

Introductory course designed for students who wish to acquire facility in translating scientific material from German to English. Introduction to fundamentals of grammar, problems of syntax and idiom, with emphasis on scientific terminology. 3 cr.

51-114 ELEMENTARY TECHNICAL GERMAN II

A continuation of 51-113, which is a prerequisite. 3 cr.

51-211 INTERMEDIATE GERMAN I*

A review of German grammar and syntax with emphasis upon increased proficiency in reading aural comprehension, and oral expression. This course is intended for students who have completed two years of high school German preferably during their junior and senior years, or 51-102. 3 cr.

51-212 INTERMEDIATE GERMAN II*

A continuation of 51-211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. 3 cr.

* Refer to footnote page 116.

Directed Studies

Directed Studies are available only to modern language majors and may be elected provided that (1) the material to be covered is not available in any German course offered during the semester in which the directed studies is contemplated, (2) instructors are willing to undertake a directed studies, and (3) no more than 9 credits of the modern language major are acquired in directed studies courses. 3 cr.

51-491 DIRECTED STUDY IN GERMAN LITERATURE

Individual research projects for modern languages. The student through regular and frequent consultation with his instructor develops a course of directed study in German literature and defines a problem for individual research. The students's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor. 3 cr.

51-492 DIRECTED STUDY IN GERMAN COMPOSITION

Individual research projects for modern language majors. The student through regular and frequent consultation with his instructor pursues a special problem of composition or creative expression. Prerequisite: permission of instructor. 3 cr.

51-495 ADVANCED TUTORIAL IN GERMAN

A program of directed studies which affords modern language majors with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and

refine techniques of scholarly research and presentation and for creative expression. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

Practicum

51-496 PRACTICUM EXPERIENCE

A program of campus and/or off-campus experiences (for modern language majors only) which are developed by the student in consultation with a member of the German staff. Specific requirements will vary, depending upon the nature of the program undertaken by the student. The intent of the practicum is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the modern language concentration. May be repeated to a maximum of 9 credits in practicum courses. Students will be graded "satisfactory" or "unsatisfactory". The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. 3 cr.

Greek (Course Prefix: 55)

55-101 BEGINNING GREEK I*

No previous knowledge of Greek required. The aims are basic oral expression, aural comprehension, and elementary reading and writing in modern and ancient Greek. Bentas. 3 cr.

55-102 BEGINNING GREEK II*

Continuation of 55-101, with readings in Greek prose and poetry. A good foundation for advanced study in modern or classical Greek. Prerequisite: 55-101, or equivalent and permission of instructor. Bentas. 3 cr.

55-211 INTERMEDIATE GREEK I*

Review and development of audio-lingual skill, writing and reading in Greek, followed by the reading of Greek texts from the classical, Byzantine and modern periods. Prerequisite: 55-101, 102 or equivalent, and permission of the instructor. Bentas. 3 cr.

55-212 INTERMEDIATE GREEK II*

Continuation of 55-211. Bentas. 3 cr.

55-301 GREEK CLASSICS I

Concentrated readings in such authors as Homer, Herodotus, Xenophon, Plato and the dramatists. Prerequisite: 55-212 or equivalent, and permission of instructor. Bentas. 3 cr.

55-302 GREEK CLASSICS II

Continuation of 55-301. Prerequisite: 55-212, or equivalent, and permission of instructor. Bentas. 3 cr.

55-303 SELECTED GREEK AUTHORS

Intensive study of a few author's works not previously studied. May be repeated for credit with approval of instructor. Bentas. 3 cr.

The following courses are conducted in English and do not satisfy any language requirement.

55-251 GREAT BOOKS OF ANCIENT GREECE

A study in the meaning and importance of the Greek pagan masterpieces, which are read in the best translations. (Subject to demand of classical civilization minors). Bentas. 3 cr.

55-252 GREAT BOOKS OF ANCIENT GREECE

Continuation of 55-251. (Subject to demand of classical civilization minors). Bentas. 3 cr.

*Beginning and intermediate language courses at the 101-102 and 211-212 levels must be elected for two consecutive semesters and in the prescribed sequences. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.

55-351 CLASSICAL DRAMA

Group reading of great plays; discussion of their meaning and importance; lectures on the Greek theatre; the origins of tragedy and comedy, the nature of drama, and the special achievements of each dramatist. Prerequisite: consent of instructor. (Subject to demand of classical civilization minors). Bentas. 3 cr.

55-451 GREEK THOUGHT

The Greek view of man and nature as revealed in myth, philosophy, science, history, art, and literature, and their relation to the modern age. Prerequisite: consent of instructor. (Subject to demand of classical civilization minors). Bentas. 3 cr.

Italian (Course Prefix: 52)

52-101 BEGINNING ITALIAN I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of Italian at the secondary level are ineligible for this course. 3 cr.

52-102 BEGINNING ITALIAN II*

A continuation of 52-101, which is a prerequisite. 3 cr.

52-103 ITALIAN FOR THE PERFORMING ARTS

This course is designed to improve the Italian diction of the music student, and to impart a basic knowledge for understanding and correctly pronouncing operatic Italian. Aste. 3 cr.

52-211 INTERMEDIATE ITALIAN I*

A review of Italian grammar and syntax with emphasis upon increased proficiency in reading, aural comprehension, and oral expression. This course is intended for students who have completed two years of high school Italian, preferably during their junior and senior years, or 52-102. 3 cr.

52-212 INTERMEDIATE ITALIAN II*

A continuation of 52-211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. 3 cr.

52-310 SPECIAL TOPICS IN ITALIAN STUDIES

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in Italian. Course content and approach will vary, depending on instructor. The department will post and distribute detailed course description each semester, and students are urged to use this information in making their selections. 3 cr.

The following courses are conducted in English and do not satisfy any language requirement and cannot be counted as part of the Modern Language major.

52-371 DANTE'S DIVINE COMEDY

A detailed study of the Divine Comedy. Consideration is given to the influence of Dante's minor works, to the unity of the poem as a synthesis of Dante's new life, and to Dante's views of the world and history. Conducted in English. Aste. 3 cr.

52-373 PETRARCH AND BOCACCIO: A STUDY IN HUMANISM

A study of the waning of the Middle Ages and the dawning of the Renaissance as seen through the work of Petrarch and Boccaccio. Emphasis will be given to the study of sources and to the influence of Petrarch and Boccaccio upon the literatures of Western Europe. Conducted in English. Aste. 3 cr.

52-374 RENAISSANCE LITERATURE OF ITALY, FRANCE, AND SPAIN

Consideration of the major works and authors of the Italian Renaissance. Relationships with counterparts in France and Spain will also be treated. Conducted in English. Aste. 3 cr.

52-376 PIRANDELLO: HIS THEATER AND INFLUENCE

A course devoted to the major dramatic works of Pirandello which have established his reputation as an entertainer and a social critic, with special emphasis upon his notion of appearance vs. reality and his influence upon contemporary French drama. Conducted in English. Aste. 3 cr.

52-378 20TH CENTURY ITALIAN LITERATURE FROM MORAVIA TO FELLINI

A guide to contemporary Italian studies, through literary and cultural approaches. The works of central figures

in contemporary Italian letters will be examined in view of their impact on Italian life. Emphasis will be given to poets, novelists, the new cinema, the influences of existentialism, and the impact of America on Italian literature. Conducted in English. Aste. 3 cr.

Directed Studies

Directed Studies are available only to modern language majors and may be elected provided that (1) the material to be covered is not available in any Italian course offered during the semester in which directed studies is contemplated, (2) instructors are willing to undertake a directed studies, and (3) no more than 9 credits of the modern language major are acquired in directed studies courses.

52-491 DIRECTED STUDY IN ITALIAN LITERATURE

Individual research projects for modern language majors. The student through regular and frequent consultation with his instructor develops a course of directed study in Italian literature and defines a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor. 3 cr.

52-492 DIRECTED STUDY IN ITALIAN COMPOSITION

Individual research projects for modern language majors. The student through regular and frequent consultation with his instructor pursues a special problem of composition or creative expression. Prerequisite: permission of instructor. 3 cr.

52-495 ADVANCED TUTORIAL IN ITALIAN

A program of directed studies which affords modern language majors with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation and for creative expression. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

Practicum

52-496 PRACTICUM EXPERIENCE

A program of campus and/or off-campus experiences (for modern language majors only) which are developed by the student in consultation with a member of the Italian Staff. Specific requirements will vary, depending upon the nature of the program undertaken by the student. The intent of the practicum is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skill which are appropriate to the modern language concentration. May be repeated to a maximum of 9 credits in the practicum courses. Students will be graded "satisfactory" or "unsatisfactory". The practicum may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. 3 cr.

Latin (Course Prefix: 56)

56-101 BEGINNING LATIN I*

A course for beginners and for students wishing to review the elements of Latin, and to acquire, thereby, an ability to read selected passages from Latin authors. 3 cr.

56-102 BEGINNING LATIN II*

Continuation of 56-101, with special attention devoted to the translation, analysis and class discussion of selected passages from Latin authors illustrating the life, culture, and contribution of ancient Rome to the modern world. 3 cr.

56-211 INTERMEDIATE LATIN I*

Readings from Latin prose and poetry, with special attention to the works of such authors as Cicero and Virgil. Prerequisite: 56-101, 102. 3 cr.

*Beginning and intermediate language courses at the 101-102 and 211-212 levels must be elected for two consecutive semesters and in the prescribed sequences. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.

56-212 INTERMEDIATE LATIN II*

Continuation of 56-211.

3 cr.

56-301 LATIN CLASSICS I

Concentrated readings in such authors as Livy, Tacitus, Horace, Juvenal, Catallus, Ovid, and Medieval Latin writers. Prerequisite: 56-201, 202, or four years of high school Latin. Bentas.

3 cr.

56-302 LATIN CLASSICS II

Continuation of 56-301. Bentas.

3 cr.

56-303 SELECTED LATIN AUTHORS

Intensive study of a few authors' works not previously studied. May be repeated for credit with approval of instructor. Bentas.

3 cr.

56-352 CLASSICAL DRAMA

Continuation of 55-351 with concentration on the Roman dramatists. Prerequisite: consent of instructor. (Subject to demand of classical civilization minors.) Bentas.

3 cr.

The following course is conducted in English and does not satisfy any language requirement.

56-452 THE ROMAN MIND

The Roman view of man and nature as revealed in law, government, social institutions, legend, and religion, and their relation to the modern world. Prerequisite: consent of instructor. (Subject to demand of classical civilization minors.) Bentas.

3 cr.

Russian (Course Prefix: 53)

53-101 BEGINNING RUSSIAN I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use.

3 cr.

53-102 BEGINNING RUSSIAN II*

A continuation of Beginning Russian I, which is a prerequisite.

3 cr.

53-113 ELEMENTARY TECHNICAL RUSSIAN I

Introductory course designed for students who wish to acquire facility in translating scientific material from Russian to English. Introduction to fundamentals of grammar, problems of syntax and idiom, with emphasis on scientific terminology.

3 cr.

53-114 ELEMENTARY TECHNICAL RUSSIAN II

A continuation of 53-113, which is prerequisite.

3 cr.

Spanish (Course Prefix: 54)

54-101 BEGINNING SPANISH I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of Spanish at the secondary level are ineligible for this course.

3 cr.

54-102 BEGINNING SPANISH II*

A continuation of 54-101, which is a prerequisite.

3 cr.

54-103 CONVERSATIONAL SPANISH FOR HEALTH PROFESSIONS

Fundamental skills in conversation for the health professions (semi-technical functional vocabulary, idiomatic expressions used by patients and doctors, and situational phrases for the health professions) with special emphasis upon those cultural and physiological characteristics of Spanish speaking peoples which influence their behavior in a health profession's setting.

3 cr.

*Beginning and intermediate language courses at the 101-102 and 211-212 levels must be elected for two consecutive semesters and in the prescribed sequence. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.

54-114 SPANISH FOR BUSINESS AND INTERNATIONAL MANAGEMENT

A continuation of 54-101 with a reading emphasis presenting to Business and Management sciences concentrators and others by means of a cultural comparison between the Hispanic and American peoples, the terminology and practices of the Hispanic business world particularly in the domains of Accounting, Banking, Management and Legal Organization. 3 cr.

54-211 INTERMEDIATE CONVERSATIONAL SPANISH I*

A review of Spanish grammar and syntax with emphasis upon increased proficiency in aural comprehension, and oral expression. This course is intended for students who have completed two years of high school Spanish, preferably during their junior and senior years, for students who have completed 54-102, and for students who are unqualified for the 221-222 sequence. 3 cr.

54-212 INTERMEDIATE CONVERSATIONAL SPANISH II*

A continuation of 54-211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. 3 cr.

54-213 INTERMEDIATE CONVERSATIONAL SPANISH II*

Designed for Criminal Justice majors, this course may replace 54-212, the second portion of the intermediate sequence. Continued development of comprehension and conversational skills will be emphasized. Students will work with relevant technical vocabulary and highly idiomatic "street" language. Cultural information will emphasize characteristics of Spanish-speaking population in the United States. 3 cr.

54-221 READING AND CONVERSING IN SPANISH I

The basic emphasis of this course is upon Spanish grammar review and the development of reading and conversational skills. Selected contemporary works provide the basis for developing conversational comprehension, conversational, and composition skills. This course is intended for students with a solid foundation in the Spanish language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 cr.

54-222 READING AND CONVERSING IN SPANISH II

A continuation of 54-221, which is a prerequisite, with emphasis upon continued development of reading and conversational skills. 3 cr.

54-234 ADVANCED SPANISH GRAMMAR & SYNTAX

A systematic study of complex grammatical and syntactical problems. Review of more advanced problems. 3 cr.

54-245 ADVANCED SPANISH CONVERSATION

Advanced oral fluency in rapid and idiomatic speech. Topics of contemporary significance will be selected from contemporary prose. 3 cr.

54-249 SPANISH CULTURE THROUGH LIGHT AND SOUND

Designed to enhance and expand the traditional civilizational course, incorporating the social and political, but in particular the cultural contributions of the Hispanic world: use of modern audiovisual materials, with the objective of reinforcing and stimulating both passive and active control of the Spanish language. Conducted in Spanish. Recommended for Spanish majors. 3 cr.

54-454 TOPICS IN CONVERSATIONAL SPANISH

Discussion of a wide spectrum of contemporary topics with the object of continuing to develop facility and accuracy of expression. Prerequisite: advanced level proficiency. 3 cr.

54-301 INTRODUCTION TO SPANISH LITERATURE

The history of Spain's literature studied in its general trends and through its major writers, revealing the complicated series of interactions, conflict and influences which have molded the unique character of the nation. Conducted in Spanish. Required of Spanish concentrators. 3 cr.

54-302 INTRODUCTION TO LATIN AMERICAN LITERATURE

A study of the major writers of Latin America from the Indigenist literature to the Modernist period. The authors

*Beginning and intermediate language courses at the 101-102 and 211-212 levels must be elected for two consecutive semesters and in the prescribed sequences. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.

and their works will be placed in their historical, sociological, and literary perspective, thus introducing students to the Latin American world. Conducted in Spanish. 3 cr.

54-313 FIELDWORK IN THE SPANISH COMMUNITY

Individual assignments under the sponsorship of local service agencies serving the Spanish speaking community, involving individual family, and group contact. Written and oral reports in Spanish. Prerequisite or corequisite: 54-212 or equivalent. 3 cr.

54-320 SPECIAL TOPICS IN SPANISH STUDIES

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in Spanish. Course content and approach will vary, depending on instructor. The department will post and distribute detailed course descriptions each semester, and students are urged to use this information in making their selections. 3 cr.

54-347 ADVANCED SPANISH COMPOSITION

A course designed to help the mature language student recognize and interpret a variety of literary styles. Also designed to develop self-expression and facility in prose writing. 3 cr.

54-372 APPLIED LINGUISTICS

Linguistics analysis of Spanish phonology, morphology, and syntax, with a systematic comparison of the structures of Spanish and English. Required for prospective teachers of Spanish in the elementary and secondary schools. 3 cr.

54-401 SELECTED AUTHORS

An intensive study of works by a few Spanish and/or Latin American authors. 3 cr.

54-403 THE GOLDEN AGE

A study of the development and character of XVIIth century Spanish drama, novel and poetry, with special emphasis on Cervantes, Lope de Vega, Calderon and Quevedo. An analytical study of some of the masterpieces from structural and stylistic points of view, taking into consideration their relation to the period and the expression of universal values. Prerequisite: 54-302 or permission of instructor. 3 cr.

54-405 THE GENERATION OF "98"

A critical study of such influential authors as Unamuno, Valle-Inclan, Baroja, Azorin, and Machado. Special emphasis is given to their personal style as a reaction to Spain's decay, as well as to their influence upon the emergence of modern Spain. Prerequisite: 54-302 or permission of instructor. 3 cr.

54-407 SPANISH PICARESQUE NOVEL

Analysis of representative works of the picaresque genre; its portrait of Spanish society; social criticism. Emphasis will be placed on Ellazarillo de Tormes, Guzman de Alfarache, El Buscon, and Rinconete y Cortadillo. Prerequisite: 54-302 or permission of instructor. 3 cr.

54-409 TWENTIETH CENTURY SPANISH LITERATURE

A study of the famous generation of 1927 and of the major literary trends during and after the Spanish Civil War. Prerequisite: 54-302 or permission of instructor. 3 cr.

54-412 THE SHORT STORY IN LATIN AMERICA

An analytical examination of the thematic and linguistic structures in major Latin American short story writers such as Borges, Cortazar, Marquez, Rulfo. Prerequisite: 54-303 or permission of instructor. 3 cr.

54-416 THE LATIN AMERICAN NOVEL

The study of the development of the Latin American novel. Three major works (Dona Barbara, Los de Abajo, and Don Segundo Sombra) will be read and analyzed in depth and placed in the historical context of the novel in Latin America. Prerequisite: 54-303 or permission of instructor. 3 cr.

54-456 SPANISH TRANSLATION SEMINAR

A study of the theory and practice of translation, aimed at developing translation skills. Material used is taken from literary works as well as newspapers and magazines. This course is intended for students with a good command of the language. Open to Spanish concentrators and others by permission of instructor. 3 cr.

The following courses are conducted in English and do not satisfy any language requirement, and cannot be counted as part of the Spanish major or the Modern Language major.

54-262 HISPANIC THOUGHT AND HERITAGE

An interdisciplinary study of Hispanic thought and consciousness. Reading and analysis of representative works of poetry, drama and fiction by outstanding Spanish writers such as Cervantes, Fray Luis de Leon, Lope de Vega, Calderon, Lorca, Unamuno. Selected works and topics such as *La Celestino*, the Picaresque literature, mystical authors. Don Juan, and some Latin-American authors will also be discussed. May be taken by Spanish concentrators but may not be credited to the major. This course is conducted in English and does not satisfy any language requirement. 3 cr.

54-315 INTERAMERICAN CULTURAL EXPRESSION

A comparative analysis of modes of expression in the cultures of Latin America and North America. The modes of expression will include films, documentaries, photography, music, painting, sports, architecture and literature. The course will explore such themes as, language, myth and reality, and self-identity, as expressed in these media. This course is conducted in English and does not satisfy any language requirement. This course may be applied to the "300" level interdisciplinary course requirement for American Studies and Latin American Studies. 3 cr.

54-375 BAROQUE LITERATURE IN SPAIN, ITALY, AND FRANCE

Consideration of the major works and authors of the Baroque in Spain. Relationships with counterparts in Italy and France will also be treated. Conducted in English. Mendicoa. 3 cr.

Directed Studies

Directed Studies are available only to Spanish or modern language majors and may be elected provided that (1) the material to be covered is not available in Spanish course offered during the semester in which a directed studies course is contemplated, (2) instructors are willing to undertake a directed studies course, and (3) no more than 9 credits in the major field are acquired in directed studies courses.

54-491 DIRECTED STUDY IN SPANISH LITERATURE

The student, through regular and frequent consultation with his instructor develops a course of directed studies in Spanish literature and defines a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor. 3 cr.

54-492 DIRECTED STUDY IN LATIN AMERICAN LITERATURE

The student, through regular and frequent consultation with his instructor develops a course of directed studies in Latin American literature and defines a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor. 3 cr.

54-493 DIRECTED STUDY IN COMPOSITION

The student, through regular and frequent consultation with his instructor pursues a special problem in composition or creative expression. Prerequisite: permission of instructor. 3 cr.

54-495 ADVANCED TUTORIAL IN SPANISH

A program of directed studies which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation and for creative expression. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

Practicum

54-496 PRACTICUM EXPERIENCE

A program of campus and/or off-campus experiences for Spanish or modern language majors only. Specific requirements will vary, depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated to a maximum of 9 credits. Students will be graded "satisfactory" or "unsatisfactory". The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. 3 cr.

DEPARTMENT OF PHILOSOPHY

Chairperson: Veda Cobb-Stevens

Professors: Robert E. Innis, Arthur I. Miller, P. Christopher Smith

Associate Professors: Veda Cobb-Stevens, Robert B. Wagner

The Department of Philosophy offers a major in philosophy which leads to the Bachelor of Arts degree. The Department also offers a minor in philosophy.

Philosophy Major

The major in philosophy is designed to serve the needs of three types of students: (1) those who seek a liberal arts education as a terminal program; (2) those who are preparing for professional graduate schools, e.g. education, law, theology, and medical schools which approve an undergraduate philosophy major; and (3) those who are preparing for graduate work in philosophy. Regardless of the goals which undergraduates may have set for themselves, a major in philosophy should be of value to all who question the reasons for things as they are, to those who seek a deeper understanding of what they are doing and for what purpose they are doing it, and to those who recognize the validity of Socrates' assertion that the "the unexamined life is not worth living".

A major in philosophy consists of 30-45 credits (with at least 15 credits at the 300 level or above). The Department does not specify particular course work for the major but recommends that the sequence of courses be designed in close consultation with the student's faculty advisor. Students who plan to go to graduate school are encouraged to take a second major in a cognate field, e.g. American Studies, English, French, history, mathematics, political science, or Spanish.

Students transferring to the College and wishing to major in philosophy must make individual arrangements with the Chairperson of the Department of Philosophy regarding satisfaction of major course requirements.

Philosophy Minor

A minor area of study consists of 18-24 credits of course work in philosophy. At least 6 credits must be selected from courses which are numbered 300 or above.

The Integrative Role of Philosophy

The majority of students in the University will neither major nor minor in philosophy. Accordingly, the department has so structured its course offerings that they intersect with issues and problems treated in other disciplines, from the natural sciences, through engineering to the social sciences and the other humanities. The department is especially concerned to show the interrelationships between not just different areas of knowledge but from different areas of existence, both individual and social. As such it wants to counteract the fragmentation of knowledge and life that is a mark of modernity. Consequently, its courses are designed to appeal to the broadest range of students and to continue philosophy's traditional role as indispensable integrator in the University's curriculum.

Philosophy (Course Prefix: 45)

45-201 INTRODUCTION TO PHILOSOPHY

An examination of some of the typical approaches to philosophical questioning and the issue raised in such inquiry: what is true knowledge, what is the good, what is the right political order, what is the nature of religious faith? Members of the department.

3 cr.

45-202 INTRODUCTION TO LOGIC

A course designed to study the methods used to distinguish correct from incorrect reasoning. It will aim at developing (1) an ability to express one's ideas clearly and concisely, (2) an increased skill in defining one's terms, and (3) a capacity to formulate arguments vigorously and to scrutinize them critically. Members of the department.

3 cr.

45-203 INTRODUCTION TO ETHICS

An examination of the basic issues and problems of ethics and value and a survey of some important alternative answers to the questions raised, on both an individual and a social level, by our necessity to act and to live in a rational and human way. Members of the department. 3 cr.

45-204 LOGIC & LANGUAGE

An examination of the role of Language in logical reasoning. Special attention will be given to the properly rhetorical elements in logical argumentation. General topics of logic will be studied from a novel point of view. Smith. 3 cr.

45-206 INTRODUCTION TO POLITICAL PHILOSOPHY

Revolutionary and conservative tendencies in the history of political philosophy will be compared and their development traced. Plato, Aristotle, Hobbs, Locke, Rousseau, Hegel, Marx, Lenin, Burke and Marcuse will be considered. 3 cr.

45-215-220 STUDIES IN THE HISTORY OF PHILOSOPHY

Great figures, periods, and problems in the history of philosophy will be subjected to an intensive semester long examination. Members of the department. 3 cr.

45-225 ORIENTAL PHILOSOPHY

An explanation of basic texts from the Indian, Chinese and Japanese traditions. An attempt will be made to understand these texts by relating them to works of Westerners who have dealt with comparable themes (Heidegger, Rilke, Thoreau). Smith. 3 cr.

45-284 PHILOSOPHIES OF ART AND BEAUTY

This course will examine the views of major philosophers on the beautiful and the nature of artistic creativity. Among others, Plato, Aristotle, Augustine, Hegel, Nietzsche and Dewey will be considered. An attempt will be made to correlate the views of these thinkers with the works of poets, artists, and composers and the statements the latter have made about their work. Smith. 3 cr.

45-285 PHILOSOPHY OF THE CREATIVE IMAGINATION

Contemporary reflection upon the dynamics of imagination has established a close correlation between creativity in the arts and discovery in the sciences. The purpose of the course will be to examine the exact nature of this correlation: to underline the similarities, while not overlooking the differences. Special attention will be given to the distinction between reproductive and creative imagination; to the function of metaphor in poetic and scientific discourse; and to the role of the conscious and unconscious processes involved in creativity activity. Cobb-Stevens. 3 cr.

45-290 PHILOSOPHY AND TRAGEDY

This course will combine a reading of several great tragic dramas with a treatment of notable philosophical texts which attempt to discern the nature of humanity and the cosmos inherent in the tragic vision. Plays will be selected from both ancient and modern tragedians, and the philosophical texts will include selections from Plato's dialogues, Aristotle's *Poetics* and Nietzsche's *The Birth of Tragedy*. Cobb-Stevens. 3 cr.

45-292 FROM MYTHOLOGY TO PHILOSOPHY: HOMER HESIOD AND THE PRESOCRATES

The transition from mythological modes of thought to the kind of philosophical inquiry which was to determine the intellectual development of the West began in Greece during the 6th century B.C. The aim of this course will be to trace in detail the nature of this transition, beginning with the Homeric poems, continuing with Hesiod's *Theogony*, and culminating with an examination of the Presocratic fragments. Reading and discussion of the texts will be done with a view toward specifying the gradual changes in conceptual frameworks which made possible new notions of the gods and the cosmos, the human self and human institutions. Cobb-Stevens. 3 cr.

45-293 PLATO AND THE BEGINNINGS OF PHILOSOPHY

The course will be concerned with Plato's attempt to deal with the questions raised by the first Greek philosophers. Special emphasis will be given to the following of Plato's dialogues: *The Georgias*, *Symposium*, *Phaedrus*, *Sophist* and *Philebus*. Particular attention will be paid to Plato's teachings on justice, eros, pleasure, and knowledge. Smith. 3 cr.

45-294 ARISTOTLE

We must only strive after that degree of precision, Aristotle holds, which the subject matter itself allows. Thus the

methodology of inquiry for the exact sciences, such as mathematics, will differ greatly from the techniques of analysis employed in investing issues concerning value. The purpose of the course will be to examine several of Aristotle's scientific writings. (e.g. *Posterior Analytics*, *On the Heavens*, *Physics*) as well as several of his works on value (e.g. *Nicomachean Ethics*, *Politics*, *Poetics*). From this methodological perspective we will inquire into the nature and significance of Aristotle's procedure and the insights which it can yield. Cobb-Stevens. 3 cr.

45-295 ETHICAL ISSUES IN TECHNOLOGY

This course will examine important ethical issues and value-conflicts emerging in contemporary science and technology. Through readings, class discussions, and guest lectures, students will not only have an opportunity to explore the manner in which ethical and technical problems are related but to develop insight into areas of ethical philosophy and modes of reasoning essential to an intelligent understanding of such issues. Wagner. 3 cr.

45-296 THE RELIGIOUS EXPERIENCE OF MANKIND

A study of religious knowledge and the phenomena of religion from a philosophical standpoint. The course will consider explanations for religious behavior, some central issues in religious belief, and the values and goals of religious systems. Various world religions will provide specific data for these topics. Wiehe. 3 cr.

45-297 MYTHOLOGY AND PHILOSOPHICAL THOUGHT IN INDIA

Much of Indian thought about reality, ultimate existence, and human values is found in extended narratives, such as the Mahabharata and Ramayana, which furnish also part of the sacred teachings of the Hindus, and early Buddhists. This course will explore the inter-relationships of Indian mythological thinking and of formalized philosophical ideas found in the six classical schools of Indian philosophy of the work of individual thinkers such as Shankara or Ramanuja. Wiehe. 3 cr.

45-300 PHILOSOPHY AND SOCIETY

An examination of the shifting nature of the chief material, symbolic, and normative premises of social, historical, and cultural processes. The course will study the interactions and intersections between the various formations in which human life objectifies itself and the tensions and distortions to which they are subject. Innis. 3 cr.

45-301 THEORY OF KNOWLEDGE

The course will study and analyze the various forms and expressions of human knowledge: perception, concept-formation and symbolic functioning, aesthetic creation and interpretation, scientific discovery and understanding, myth, and the individual, social and historical conditions to which they are subject. The goal of the course is a comprehensive view of the structure of the human mind and its operations. Innis. 3 cr.

45-302 EXISTENCE AND ANXIETY

A survey of existential philosophy and literature with reference to the traditional philosophy which existentialism calls into question, Kafka, Camus, Buber, Rilke, Nietzsche and Musil will be discussed. Smith. 3 cr.

45-303 PHILOSOPHY AND TECHNOLOGY

A philosophically oriented systematic examination of the chief aspects—material, economic, political, cultural, aesthetic, ethical—of the process by which the human race rates and embodies itself in tools and instruments. Innis. 3 cr.

45-304 GOD AND PHILOSOPHY

The course will study, historically and systematically, the following topics: (a) the origin and content of the idea of God, (b) the possibility of affirming God, philosophically and religiously, (c) the complex nature of religious language and imagery, (d) God's relation to the world, history and the individual. Innis. 3 cr.

45-305 LANGUAGE, SIGNS AND SYMBOLS

An examination of the various grammars of human expressions from the point of view of a general theory of signs. Among the topics to be treated are: (a) the nature of signs, symbols, and meaning, (b) the structures and functions of language, (c) the relations between language thought and reality, especially as manifested in metaphor, (d) the social dimensions of signification and symbolization, (e) the relations between the different linguistic, sign, and symbol systems. Innis. 3 cr.

45-306 RELIGIOUS EXISTENTIALISM

In considering works of Pascal, Kierkegaard and Heidegger an attempt will be made to work out a possible response to Nietzsche's radical challenge to the Judeo-Christian tradition. Smith. 3 cr.

45-307 SARTRE

The purpose of the course will be reflective reading of a number of Sartre's works, both philosophical and literary. Special attention will be given to his theory of consciousness as freedom, which provided the basis for the creativity of imagination, as well as for the sudden apprehension of anguish. Additional themes will include: emotion as a magical transformation of the world, the interpretation of symbols in existential psychoanalysis, and the sado-masochistic dimensions of interpersonal relationships. Cobb-Steven. 3 cr.

45-308 PHILOSOPHY OF LAW AND PROBLEMS IN CRIMINAL JUSTICE

An introduction to philosophical principles and theories underlying the institutions of law and criminal justice. Students will: (1) study the purpose and functions of law in a democratic society, (2) examine the philosophical grounds for authority and legal obligation, (3) analyze and attempt to resolve the long standing dispute between the utilitarian and retributive, theories of criminal justice, (4) evaluate the concepts of punishment, rehabilitation, and treatment in dealing with criminal behavior, and (5) assess the philosophical basis of current problems and issues confronting the criminal justice system. Wagner. 3 cr.

45-311 PHILOSOPHY OF MIND

The status of consciousness is the central concern of a philosophy of mind. The course will take its point of departure, a reflection upon the nature and significance of consciousness, from the perspective of its advocates (Husserl, Sartre) and its adversaries (Ryle, Skinner). The results of this preliminary inquiry will provide a foundation for the exploration of other issues: the possibility of an unconscious; the temptation of bad faith; the dynamics of concept formation; and the nature of emotion, imagination, and dreams. Cobb-Stevens.

45-312 PHILOSOPHY OF SCIENCE

This course will explore the ways in which science has been understood in different historical periods. An investigation will be made of the kinds of propositions which are strictly scientific; the methods which are appropriate to scientific inquiry; and the nature, origins and cultural implications of scientific revolutions. In addition, attention will be given to certain key (e.g. space, time, causality) which have played a central role in the history of science, in order to correlate changes in these concepts with developments undergone by the notion of science as such. Miller.

45-313 THE PLATONIC TRADITION

An exploration of the intertwining of the rational and mystic, and philosophical and poetic elements in Aristotle, in Plotinus' *Enneads*, Goethe's *Faust*, and the poetry of Holderlin. The course will examine the stages of consciousness as it moves through the limits of "scientific" understanding to re-unification with the divine. Smith.

45-315-325 PHILOSOPHICAL CLASSICS

A close study of some of the masterpieces of philosophical literature. In general one or two major works will be selected and subjected to a thorough reading. Members of the Department.

45-327 PHILOSOPHICAL PROBLEMS OF SPACE AND TIME

An inquiry into the development and impact of Albert Einstein's special theory of relativity that focuses on the philosophical and physical transformation of the concepts of space, time and causality. Analysis of these concepts begins with a survey of their status within the philosophical frameworks of Hume, Kant, Newton, and Poincare. Readings from contemporaneous sources and from philosopher-scientists of the late 19th and early 20th centuries. Prerequisite: 95-245. Miller. 3 cr.

45-328 TOPICS IN PHILOSOPHICAL PROBLEMS OF RECENT SCIENCE

Analysis of the changing philosophical conceptions of space, time, causality and substance brought about by developments in 20th century physical science, such as the special and general theories of relativity, statistical mechanics, nuclear physics, quantum theory, cosmology and elementary-particle physics. The interplay between philosophy and science that is a necessary part of research on the frontiers of science is studied through reading original papers by Bohr, Born, Einstein, Heisenberg, Planck, and Schrodinger, among others. The emphasis on subject matter will vary from year to year. Prerequisite: 95-425. Miller. 3 cr.

45-401 SEMINAR IN THE PHILOSOPHY OF SCIENCE

Topics vary from year to year and include: the nature of scientific discovery; case studies in the scientist as philosopher; philosophy of quantum mechanics. Prerequisite: Permission of instructor. Miller. 3 cr.

Directed Studies

Directed studies courses are available only to majors in philosophy and may be elected provided that (1) the material to be covered is not available in any course offered during the semester in which a directed studies course is contemplated, (2) instructors are willing to undertake a directed studies course, and (3) no more than 9 hours of credit in the major field is acquired through registration for and completion of directed studies courses. 3 cr.

45-491 DIRECTED STUDY IN PHILOSOPHY

The student through regular and frequent consultation with his instructor pursues a special problem in philosophy, the results of which are presented in a significant paper. Prerequisite: permission of instructor. 3 cr.

45-495 ADVANCED TUTORIAL IN PHILOSOPHY

A program of directed studies which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

DEPARTMENT OF PSYCHOLOGY

Allie Scruggs, Chairperson

Professors: Allie Scruggs, Mary Roth Walsh

Associate Professors: Janet Burke, Jon Hellstead, Charlotte Mandrell, D. Schildkraut, Richard Siegel, Joseph Waterman

Assistant Professors: Joan Cannon, Kathleen Hulbert, Robert Kunzendorf, David Landrigan, Anne Mulvey, Charles Nikitopoulos, Gloria Seeman, Linda Silka

The Department offers a major which leads to the Bachelor of Arts degree and also offers a minor area of studies.

Psychology Major

The major in psychology should be of value to students interested in the study of human and animal behavior and is intended to augment a student's general liberal arts education as well as to provide the basis for specialized professional and graduate training for careers in mental health, special education, laboratory research, social work, and teaching. The major stresses the importance of familiarity with the scientific methods of psychology, while also providing students with a solid background in the main sub-fields of psychology (experimental, developmental, social, personality-clinical) as well as the opportunity for advanced in-depth study in specialized areas. Students are also encouraged to become involved in University of Lowell community programs or in projects of supervised independent research, and the Department offers special awards to graduating seniors who have made outstanding achievements in these activities.

The major in psychology consists of 33-45 credits (with at least 15 credits at the 300 level or above) and must include the following courses:

1. Each of the following courses:
 - 47-101 General Psychology
 - 47-269 Research Methods
2. One course in each of the following four areas:
 - a. Developmental Psychology
 - 47-261 Child Psychology
 - 47-262 Adolescent Psychology
 - 47-264 Maturity and Aging(Please note: 47-163, The Human Lifespan, may not be used to fulfill this area requirement and is not recommended for majors.)
 - b. Social and Community Psychology
 - 47-209 Social Psychology
 - 47-255 Community Psychology
 - c. Personality and Clinical Psychology
 - 47-232 Psychology of Personality
 - 47-272 Abnormal Psychology
 - d. Experimental Psychology
 - 47-276 Theories of Learning
 - 47-277 Sensation and Perception
 - 47-278 Cognitive Psychology of Language and Thinking

3. One Research Laboratory course from any of the four areas:
 - a. Research Laboratories in Experimental Psychology.
 - 47-375 Research Laboratory in Experimental/Animal Psychology
 - 47-376 Research Laboratory in Experimental/Perception Psychology
 - 47-377 Research Laboratory in Experimental/Cognitive Psychology
 - b. Research Laboratory in Social Psychology
 - 47-378 Research Laboratory in Social Behavior
 - c. Research Laboratory in Developmental Psychology
 - 47-379 Research Laboratory in Developmental Psychology
 - d. Research Laboratory in Personality-Clinical; Psychology
 - 47-380 Research Laboratory in Personality-Clinical Psychology
4. Two courses at the 400 level, not more than one of which may be 47-491, Directed Studies in Psychology, or 47-496, Practicum in Psychology.
5. The remaining two to six courses of the major may be elected from any of the course offerings in psychology, except that at least 15 credits of the 33-45 required in the major must be at the 300 or 400 level. Human Sexuality, 82-351, may be counted towards this requirement.

Students transferring to the College and wishing to major in psychology must make individual arrangements with the Chairperson of the Department regarding satisfaction of major and collateral course requirements.

Minor Requirements

A minor in psychology consists of 18-24 credits of course work. At least 6 credits must be taken in course work at the 300 level or above, in fulfilling the requirements for this minor area. The three credit hours granted 82-351, Human Sexuality, may count as part of minor area requirements.

Master of Science in Community-Social Psychology

The Department also offers a Master's level program in Community-Social Psychology. For information regarding the objectives and requirements of this graduate program, consult the "Bulletin of Graduate Studies."

Psychology (Course Prefix 47)

47-101 GENERAL PSYCHOLOGY

Intended as an introductory course both for non-concentrators and for concentrators, this course surveys the major areas of psychology: the nature of psychology as a science, principles of learning, the relationship between physiological and psychological processes in humans and animals, sensation and perception, cognitive processes, motivation and emotion, personality and development, adjustment and behavior disorders, and social behavior.

3 cr.

47-150 RESEARCH CONSUMERISM

Designed primarily for non-concentrators, this course emphasizes understanding research from the consumer perspective. Students will learn to evaluate research through the examination of research reports from common media sources. The course is intended for students who are not likely to be researchers, but who will have occasion in their personal or professional lives to use research findings.

3 cr.

47-163 THE HUMAN LIFESPAN

Recommended for non-concentrators, this course surveys the major theories, stages, and processes in human development from birth to death. Students who have already taken a 200 level course in developmental psychology may not take this course for credit.

3 cr.

47-209 SOCIAL PSYCHOLOGY

An introduction to the study of social behavior in interpersonal relationships, groups, organization, and the community. Topics include attitudes and attitude change, group dynamics, interpersonal influence, and non-verbal communication.

3 cr.

47-232 PSYCHOLOGY OF PERSONALITY

An introduction to the study of human personality, including such topics as self-concept, anxiety and adjustment, achievement motivation. Psychoanalytic humanistic, cognitive, and behavioral theories of personality are stressed with consideration of the interplay between theory and research.

3 cr.

47-255 COMMUNITY PSYCHOLOGY

A survey of the nature and practice of community psychology, including principles of community organization and change, as seen in such areas as education, mental health, corrections, and social services. Students will participate in field research or practice under the direction of an assigned agency, and classroom work will include discussion of the field experiences of the participants. 3 cr.

47-261 CHILD PSYCHOLOGY

An introduction to theory and research in the field of child psychology. Using a chronological approach, the course covers the concepts and processes of child development. 3 cr.

47-262 ADOLESCENT PSYCHOLOGY

An examination of developmental issues during adolescence, including personality development and the emergence of identity, peer relations, the development of moral values, and sources of maladjustment. 3 cr.

47-264 MATURITY AND AGING

An exploration of psychological development during adult years and later life, including issues of personal, family, and occupational adjustments: psychological disorders of adult life and old age; and the psychology of aging and death, with particular reference to contemporary American attitudes and practices. 3 cr.

47-269 RESEARCH METHODS

An integrated approach to methods of scientific research in psychology, including research design and the use of statistics, the interpretation of data and the role of the scientific method in psychology. 3 cr.

47-272 ABNORMAL PSYCHOLOGY

An introduction to the study of various patterns of neurotic, psychotic, and personality disorders, with consideration of issues of diagnosis, etiology, and treatment in terms of contemporary theory, research, and practice. Prerequisite: 47-101. 3 cr.

47-276 THEORIES OF LEARNING

This course traces the development of theories of learning from early molar theories to more recent molecular ones. Current issues of importance in the study of learning will be stressed. 3 cr.

47-277 SENSATION AND PERCEPTION

This course focuses on human sensory and perceptual capacities. People know the objects and events of the world through the experiences of hearing, seeing, smelling, tasting, moving, and touching. In this course, students examine the bases of experiences which correspond to independent measures of the world and illusory experiences. 3 cr.

47-278 COGNITIVE PSYCHOLOGY OF LANGUAGE AND THINKING

This course examines the psychological bases of verbal and visual reasoning, logical and creative thought-processes, and linguistic and conceptual behaviors. The nature and limits of both the knowledge and the artistic expression which result from such processes are discussed. 3 cr.

47-300 COMPUTERS IN PSYCHOLOGY

An introduction to the use of computers in psychology, including data processing and analysis, simulation and gaming, and modeling of behavior. The emphasis is on practical experience with the quantitative side of psychology. 3 cr.

47-312 PRINCIPLE OF BEHAVIOR MODIFICATION

Based on the principles and findings of experimental studies of behavior, this course examines various methods and techniques suitable for the modification of human behavior, with consideration of how such methods can be used in education, mental health and corrections, and self-directed personal change. Prerequisite: 47-101 or 111; 47-276 preferred. 3 cr.

47-328 DYNAMICS OF INTERPERSONAL RELATION

An analysis of psychological dynamics in interpersonal behavior, emphasizing such topics as conformity, leadership, interpersonal growth, self-disclosure, personal styles of interaction and communication, and techniques of change. The primary focus will be on the behavior of the students themselves, who will be expected to participate in the classroom. The course is taught without a prerequisite, but is open only to juniors and seniors. 3 cr.

47-329 ADVANCED DYNAMICS OF INTERPERSONAL RELATIONS

An advanced training program for persons with previous training in interpersonal relations. Educational procedures and techniques of facilitation in the interpersonal relations will be discussed. An emphasis will be placed on experimental opportunities, and persons accepted will assist as junior staff members in the Dynamics of Interpersonal Relations Laboratory. Prerequisite: 47-328 or equivalent with instructor's permission. 3 cr.

47-332 HISTORY OF PSYCHOLOGY

This course examines the historical roots of psychology, from the pre-scientific psychologies of the ancient Greeks, to the twentieth century schools of the introspectionists, the Gestalt psychologists, the behaviorists, and the psychoanalysts. Historical resolutions to recurring issues are contrasted with modern resolutions. Prerequisite: 47-101 or 111. 3 cr.

47-335 PSYCHOLOGY OF WOMEN

A consideration of such topics as: the psychology of sex differences; sex roles and socialization; sex stereotypes and attitudes toward women; women's self-concept and achievement; biological basis of psychological sex differences; the nature of female sexuality; clinical theory and practice concerning women; women as mental patients and mental health consumers; implications for psychology and for women's status. 3 cr.

47-352 PSYCHOLOGICAL TESTING

A survey of major tests and techniques used to assess mental abilities, vocational interests, attitudes, and personality; an introduction to the various professional settings in which testing and assessment methods are used (e.g., mental health, rehabilitation, employment and personnel selection, criminal justice). Students learn to administer, score, and interpret specific tests, and learn how to develop a case study or report based on test data and related information. Prerequisite: 47-101 or 112. 3 cr.

47-364 PSYCHOLOGY OF CRIME AND CORRECTIONS

An investigation of the psychological aspects of crime and deviance and the nature of punishment and rehabilitation. Clinical case histories of criminal personalities will be studied in conjunction with contemporary psychological theory and research concerning anti-social and delinquent behavior. The nature of prisons and the criminal justice system, as well as aspects of psychological services, will also be considered. Prerequisite: 47-101 or 112. 3 cr.

47-369 STATISTICS IN PSYCHOLOGY

An introduction to basic statistics used in psychology, including descriptive statistics, sampling, the normal distribution, correlation and regression, and inferential statistics (t test, chi-square, analysis of variance). Prerequisite: 47-269 or consent of instructor. 3 cr.

47-371 BEHAVIOR PROBLEMS OF CHILDHOOD

This course examines specific aspects of disorders occurring during childhood and early adolescence, including neurotic disorders, autism and psychosis, retardation and learning disabilities, and conduct disorders. Case histories and research dealing with assessment, etiology, and treatment will be presented. Prerequisite: 47-261 or 272. 3 cr.

47-372 COMPARATIVE PSYCHOLOGY OF ANIMAL BEHAVIOR

Animal behavior will be identified and classified. The relations between behaviors of similar and different species will be subjected to a comparative analysis and examined in terms of evolutionary origin, development, conditioning, anatomical structures, and environmental influences. Methods of comparative research will be considered. Prerequisite: 47-269, or consent of instructor. 3 cr.

47-373 THE BIOLOGY OF BEHAVIOR

A survey of issues and topics dealing with the physiological and evolutionary bases of behavior. Biological systems and processes that influence behavior are considered, with particular emphasis on brain mechanisms. Recent discoveries in the neurosciences will be presented. Methods of research will be reviewed. Prerequisite: 47-269, or consent of instructor. 3 cr.

Research Laboratories in Psychology

The following six courses represent the electives open to students to fulfill their Research Laboratory requirement for the major. At least one course will be offered each semester; some will be offered more frequently than others.

All six laboratory courses involve both classroom and laboratory work, and they are designed to introduce the student to the methods and principles of experimental and/or observational research. Students will conduct their own research under supervision and will be required to submit regular laboratory reports. Please note that both class and laboratory must be taken for credit, and that all laboratory courses carry 47-269 (Research Methods) as a prerequisite.

47-375 RESEARCH LABORATORY IN EXPERIMENTAL ANIMAL PSYCHOLOGY

(Previous title: Experimental Psychology: Learning)

The focus of this course is on basic principles of learning and behavior, derived from animal studies. Emphasis will be on environmental and evolutionary determinants of behavior. Experimental studies using non-human subjects will be required. Prerequisite: 47-269; 47-276 or 277 or 278. 3 cr.

47-376 RESEARCH LABORATORY IN EXPERIMENTAL / PERCEPTION PSYCHOLOGY

This course introduces students to research in sensation and perception. Students can gain a firm grounding in the fundamentals of psychological research through a beginning series of instructor designed laboratory projects. Students will develop skills in asking and answering questions about human capacities to experience the world and apply those skills to an original research project. Hearing, seeing, smelling, tasting, moving, and touching may be examined for instances of correspondence between experiences and independent measures of the world or for instances of illusion. Prerequisite: 47-269; 47-276 or 277 or 278. 3 cr.

47-377 RESEARCH LABORATORY IN EXPERIMENTAL & COGNITIVE PSYCHOLOGY

This course emphasizes research into human cognitive processes: the processes of perceiving, remembering, imaging, thinking, and communicating. Students develop the skills necessary to complete original research projects on cognitive issues of their own choosing. Prerequisite: 47-269; 47-276 or 277 or 278 or 340. 3 cr.

47-378 RESEARCH LABORATORY IN SOCIAL BEHAVIOR

The focus of this course is on social behavior studied within the experimental framework. The course is designed to introduce students to the experimental method as applied in social psychology, to teach them the skills necessary to complete an original research project, and to help them to develop an understanding of the activities typically engaged in by researchers. Prerequisite: 47-269 and 47-209. 3 cr.

47-379 RESEARCH LABORATORY IN DEVELOPMENTAL PSYCHOLOGY

This course covers some of the various research techniques utilized in the study of human development over the life span (observational techniques, case studies, psychological tests and measures, field studies, quasi-experimental and experimental methods). Students develop the skills necessary to carry out original research projects on aspects of developmental psychology, under faculty supervision. Prerequisite: 47-269; 47-261 or 262 or 264. 3 cr.

47-380 RESEARCH LABORATORY IN PERSONALITY-CLINICAL PSYCHOLOGY

This course emphasizes various research techniques (experimentation, observation, and the collection and correlation of data through various scales and inventories) in areas of personality psychology, abnormal behavior, and/or techniques of treatment. Students develop the skills necessary to complete original research projects on personality-clinical issues. Prerequisite: 47-269; 47-232 or 272. 3 cr.

Advanced Seminars

The following 400 level seminars are designed primarily for upperclass majors in psychology, and any of them may be used to satisfy the 400 level requirement (6 credits) of the concentration. They are all taught with prerequisites and involve a high degree of independent work in field experience and/or research. Emphasis is on current developments in specialized areas of psychology reflecting the expertise of members of the faculty. The descriptions provided below should be considered only in general terms: Seminars are highly individualized and vary considerably in content and approach from one instructor to another. Each semester, the Department will post notices providing more detailed descriptions, and students are urged to utilize this information in making their selections. Seminar enrollments will be strictly limited, and a high degree of student participation is expected.

Each year at least one specific seminar in each of the general areas will be offered. Students may enroll for as many different seminars as they wish, including as many as two seminars in the same general area, provided only that no seminars taken for credit cover the same specific topics.

47-473 SEMINAR IN SOCIAL PSYCHOLOGY

Intensive study of one or more of the following special topics in social psychology: small group interaction: conformity: attitude formation and prejudice: patterns of communication, including non-verbal communication: social roles and social interaction: the psychology of sex roles: methods of social action and social change in the community: etc. Prerequisites: 47-269 and 209. 3 cr.

47-474 SEMINAR IN DEVELOPMENTAL PSYCHOLOGY

Careful consideration of selected topics in the area of human development, including the following: psychology of the family and parent-child relations, infant development, the development of language and intelligence, the adolescent in modern American society, moral development, adjustment during adulthood, death and dying, etc. Prerequisites: 47-269; 47-261 or 262 or 264. 3 cr.

47-475 SEMINAR IN CLINICAL PSYCHOLOGY

This seminar will focus on such topics as the following: the nature of psychotherapy and clinical practice, analysis of specific clinical theories of psychopathology and psychotherapy (transactional analysis, Gestalt, psychoanalysis), the nature and causes of specific psychological disorders (schizophrenia, affective disorders, etc.), the nature of mental hospitals, the community mental health movement, clinical methods of assessment, current topics in personality theory and research, etc. Prerequisites: 47-269; 47-232 or 272 or 355. 3 cr.

47-476 SEMINAR IN EXPERIMENTAL PSYCHOLOGY

Intensive study of specific topics and areas of psychological research from among the following: the experimental analysis of behavior, sensation and perception, cognitive psychology, the biology of behavior, the comparative study of animal behavior, and other selected topics related to experimental psychology. Prerequisites: 47-269; 47-275 or 276 or 277 or 340 or 372 or 373. 3 cr.

47-477 SEMINAR: Contemporary TRENDS IN PSYCHOLOGY

This seminar will be offered from time to time, reflecting special interests of the psychology faculty. Specific topics related to the most contemporary areas of psychological practice and/or research and their implications for future developments in the field will be covered. Prerequisite: 47-269 and/or courses to be specified by the instructor. 3 cr.

Directed Study

Directed studies are available only to psychology majors and may be elected provided that (1) the material to be covered is not available in any course offered during the semester in which a directed studies/advanced tutorial is contemplated, (2) instructors are willing to undertake the supervision of the student's work, and (3) no more than 9 credits in the major are acquired in directed studies/advanced tutorials.

Directed studies offer a student the opportunity to engage in an independent study or research project during an academic semester under the supervision of a department member. The topic for such work will be jointly determined by the student and his/her supervisor. Interested students are required to apply to the Department one month prior to pre-registration for the semester in which they wish to enroll. These application must be on form available at the Department office and will be reviewed to determine

- (a) feasibility of the proposed work
- (b) Availability of an appropriate faculty supervisor
- (c) ability of the student to engage in this concentrated and sustained effort.

Students are advised to examine the list of department members and their specialized fields of interest before writing their study proposal for the application. Each student who is accepted for a directed study/advanced tutorial will be responsible for submitting a final version of the proposal to the Department before the end of the Drop-Add period of the semester during which the work is undertaken. Although no prerequisites have been set, it is expected that the student will approach this study with the basic theory and the academic and technical skills essential in high level work, and ordinarily only juniors or seniors will be considered.

47-491 DIRECTED STUDY IN PSYCHOLOGY

Through frequent consultation with the instructor, the student will carry out the investigation of a particular

specialized area of interest. One semester of directed studies (or one semester of practicum, but not one semester of each) may be counted toward satisfaction of the 400 level requirement of the major. 3 cr.

47-495 ADVANCED TUTORIAL IN PSYCHOLOGY

An opportunity for the student to work at the highest level of specialization and independence on a project of his or her own design. Careful consultation with the faculty is necessary. Prerequisite: 47-491. 3 cr.

Practicum

47-496 PRACTICUM IN PSYCHOLOGY

A program of campus and/or campus experience for psychology majors only. Specific requirements will vary, but the practicum experience is designed to enable upperclass students to work and study in a variety of areas related to psychological practice and research (mental health agencies, hospitals, prisons, schools, university programs, etc.). Practicum may be repeated for a maximum of 9 credits. Students will be rated "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for any required course in the major, but one semester of practicum (or one semester of directed studies, but not one of each) may be counted toward satisfaction of the 400 level requirement of the major. Prerequisite: permission of the Department or designated faculty member, which must be obtained 2 weeks prior to pre-registration of the semester in which the practicum is to be taken.

Graduate Courses in Community-Social Psychology

For 500-level graduate courses, consult the "Bulletin of Graduate Studies".

DEPARTMENT OF SOCIOLOGY

Chairperson: Carol Brown

Professor: Shirley Kolack

Associate Professors: Carol Brown, Leon Chorbajian, Mitra Das, John MacDougall

Assistant Professor: William Harrison, Marie O'Brien, Frederick Sperounis

The Department of Sociology offers a major leading to the Bachelor of Arts degree and also a minor area of studies

Sociology Major

The major in sociology offers students the opportunity to understand the nature of social life in our own and other societies. It provides a unique perspective from which to gain a systematic view of material in a large number of different fields. Courses within the Department therefore cover a wide range of fields and encompass such topics as other-world cultures, ethnic cultures, the dynamics of social policy, relationships between sexes, the nature of industrial capitalism, and the impact of technology on modern society. Students are encouraged to do work in the Lowell area as part of their sociology program. A prevalent value within the Department is the search for meaningful social change. Students who are interested in social work, law, teaching, or full-time academic work might consider a major in sociology.

A major in sociology consists of 30-45 credits (with at least 15 credits at the 300 or 400 levels) and must include the following:

1. 48-101 Introduction to Sociology
2. 48-321 Social Theory
3. 48-402 Sociological Research
4. One other 400 level course

Students transferring to the College and wishing to major in sociology must make individual arrangements with the Department Chairperson regarding satisfaction of major course requirements.

Sociology Minor

A minor area of study consists of 18-24 credits of course work in sociology. At least 6 credits must be taken in course work at the 300 level or above.

Sociology (Course Prefix: 48)

48-101 INTRODUCTION TO SOCIOLOGY

This is the basic course of sociology. Emphasis is directed at the ways in which social institutions such as government, schools, and economy, social class, and the family develop and influence our lives. It is concerned not only with presenting various ways to understand our relationship to society, but also with ways to change it. Prerequisite to all Sociology courses. 3 cr.

48-131 SOCIOLOGY THROUGH LITERATURE

An attempt to understand society through the study of fiction. Emphasis is placed upon contemporary literature. 3 cr.

48-193 FUTURISTICS I: A STUDY OF ALTERNATIVE FUTURES

An introduction to the study of possible futures as an academic discipline. Topics assigned for discussion include: why we look at the future and how; forecasting; optimism versus pessimism; possible starting points for a revolution of our past, present, and future; four fundamental dilemmas of the *Technological Affluent Service Society*; nine bad problems—branches of our future dilemma; chances for change. Harrison. 3 cr.

48-195 FUTURISTICS II A: MATERIAL TRENDS

An investigation of the Technological Affluent Service Society using science fiction works of sociological importance and related scholarly texts. Beginning with a consideration of the pessimistic outlook of Robert Heilbroner's *Inquiry into the Human Prospect*, the course focuses on current attitudes derived from recent topical events, the promise or failure of democratic and socialist ideals and the ambivalence of "progress" derived from science and technology. Discussion will explore the great challenges ahead, stemming from nuclear pessimism, environmental deterioration, and population pressures. Automation, the car, the city in the future will also be considered. Harrison. 3 cr.

48-201 SOCIAL ANTHROPOLOGY

Using the comparative approach to the society, this course examines several distinct cultures as a means of understanding both the universal constants and the variations in human societies. Chorbajian, Das. 3 cr.

48-212 CULTURES OF THE WORLD

This course will focus on a different country or continent each time it is given. Students will examine the traditional culture, recent history, economic development, class structure and international relations of the area covered. See the department chairperson for specifics. 3 cr.

48-220 SELF ASSESSMENT AND CAREER DEVELOPMENT

A study of the meaning of work in our society. Class participants will assess their own life experiences, keep journals and develop a plan to integrate their interests, values and abilities into meaningful and realistic life/work patterns. Oatis and Crews. 3 cr.

48-223 THE SOCIOLOGY OF CAPITALISM

This course examines the social roots of the capitalist economic system. It focuses on the development of private property, the business corporation, social class, and imperialism. How does this economic system influence other social institutions and the way we live today? What are the alternatives? 3 cr.

48-231 THE SOCIOLOGY OF THE FAMILY

A study of the nature of the family in contemporary society with particular emphasis on the family in America. What functions does the family perform in modern society? How is it changing? How do these changes affect our lives? Das. 3 cr.

48-234 THE STUDY OF MINORITIES

This course examines the process of immigration and majority-minority relations in the U.S. over the last century with particular emphasis on the process of adaptation in a pluralistic society. Prerequisite 48-101. 3 cr.

48-235 THE BLACK EXPERIENCE IN AMERICAN LIFE

A careful examination of the role and status of the Black in the United States since slavery. Prejudice, racism, and Black separatism are emphasized. 3 cr.

48-241 WOMEN IN SOCIETY

An examination of the ideas of major feminist thinkers and material from the women's movement tested against

the actual life experience of class participants. The course will be a search for an understanding of the roles of women in society. Of paramount concern will be answers to the questions, "What do we want?" and "What do we need?" Particular topics might include female sexuality, the health care system, the role of women under capitalism, women in third world countries. Prerequisite: permission of instructor. 3 cr.

48-256 POLITICAL SOCIOLOGY

This course focuses on the development and use of power in modern society. Emphasis is placed on the relationship of American political institutions to economic institutions, to social class, and to supporting ideologies. Prerequisite: 48-101 or permission of instructor. 3 cr.

48-260 MASS MEDIA AND COMMUNICATIONS

This course investigates the structure of mass communications and the impact of the media on our lives. A full range of media are considered, including television, radio, cinema, the press. The potential impact of new media sources such as cable TV are also considered. Brown. 3 cr.

48-262 SOCIAL ECOLOGY, POPULATION AND RESOURCES

An examination of the impact of human society on the planet Earth. Particular attention is given to such issues as the impact of the economy on the environment and the social, political and moral implications of population controls. 3 cr.

48-296 FUTURISTICS IIB: SOCIAL AND ECONOMIC TRENDS

An investigation of the Technological Affluent Service Society using science fiction works of sociological importance and related scholarly texts. Continuing with further consideration of Robert Heilbroner's *"Inquiry into the Human Prospect"*, the course considers the social and economic resiliency of the T.A.S.S. in dealing with the challenges ahead. Topics assigned for discussion include: interpersonal behavior; institutional arrangements; social organization; culture; child rearing practices; alternative family forms; and slicing the economic pie. Harrison. 3 cr.

48-298 FUTURISTICS IIIA: TOWARDS THE MATURE SOCIETY

A seminar diagnosing the future of the United States as a Technological Affluent Service Society with the object of prescribing remedies. A medical metaphor—"That American Society is ill"—underlies the course which will discuss how it might be made well. A psychological metaphor—"That American Society is in its adolescence"—tempers the previous theme. Discussions will focus on "Moving toward a New Society"; a class experience with the new revised SIMOC (Simulated Society) will follow; and the course will conclude with an examination of the University of Lowell as a case study of applied utopianism. Harrison. 3 cr.

48-299 FUTURISTICS IIIB: WORLD ORDER—TOWARDS SPACESHIP EARTH

This course considers the evolution of the global political system from 1945 thru the year 2000. Topics included; The concept of "world order" versus "world politics"; designing tomorrow today; the U.S. and the world politics system; drastic forms of the world order challenge; analysis, and scenarios for an alternative system; positive forms of a world order response: strategies for an alternative system; summary; "future worlds." Harrison. 3 cr.

48-321 SOCIAL THEORY

An examination of the most important social theorists, both historic and recent. Students will learn how theory is created, and how it is linked to facts. Brown, Sperouinis. Prereq: 48-101, Plus 2 other sociology courses. 3 cr.

48-312 MODERN AFRICA: CONFLICT AND STRUGGLE

The impact of European imperialism on Africa will be studied in its economic, political, social and cultural dimensions. Among the issues discussed will be nationalism, class struggle, neo-colonialism and the on-going liberation struggles in Southern Africa. Prerequisite: 48-101. Chorbajian. 3 cr.

48-323 THE SOCIOLOGY OF IDEAS AND VALUES

A consideration of the ways in which ideas and values arise in society and in turn influence social action. Included are scientific facts, myths, ideologies, religions, morals and common-sense beliefs. Prereq. 48-101. 3 cr.

48-341 SOCIAL STRATIFICATION

This course focuses on the phenomenon of social class distinctions with particular emphasis on social class in America. The approach taken is both historical and sociological. Prerequisite: 48-101. 3 cr.

48-345 URBAN SOCIOLOGY

This course deals with issues related to the quality of life in American cities. Students taking this course may engage in research projects on the city of Lowell and the role of the University of Lowell within that city. Prerequisite: 48-101. 3 cr.

48-347 SOCIOLOGY OF SPORTS

This course treats sport as a social institution, analyzing the growth and development of amateur and professional sport in the U.S. and in other nations. Special attention is paid to such issues as sport and its relation to race, sex, socialization, political economy, the mass media and international relations. Prerequisite 48-101. Chorbajian. 3 cr.

48-350 SOCIAL SERVICE: IDEOLOGY AND REALITY

An examination of the structure of social welfare services in America. Attention is directed at the functions that welfare and mental health institutions service in American society; the ideologies that surround these institutions; and the role of the social worker within them. Prerequisite: 48-101 3 cr.

48-351 THE SOCIOLOGY OF HEALTH AND HEALTH CARE

A historical and contemporary study of the socio-politics of health, illness, and the health care industry in the United States. Attention is given to providers, consumers, owners, workers, and professionals in terms of their power, class, race, sex, and age. Reforms and alternatives are considered. Prerequisite: 48-101, or permission of instructor. MacDougall. 3 cr.

48-357 THE SOCIOLOGY OF RELIGION

An investigation of religious institutions and experiences. Emphasis is placed on the influence of religion on social change. Chorbajian. Prerequisite: 48-101. 3 cr.

48-361 THE SOCIOLOGY OF LAW AND THE CRIMINAL JUSTICE SYSTEM

Introduction to the theory, structure, ideology, and practice of the criminal justice system. Particular attention is directed at the definition of crime and the impact of social, political, and economic policy on the operation of systems and their impact on its "clients". Prerequisite: 48-101, or permission of instructor. O'Brien. 3 cr.

48-382 SOCIAL MOVEMENTS

This course considers organized action undertaken to alter the social position of a group. Organization, techniques of action, motivation of participants, and group ideologies are studied. Materials from historical, social psychological, and sociological sources are used. Prerequisite: 48-101. Das. 3 cr.

Advanced Courses

The following courses are intended primarily for upperclass majors. Students should have a minimum of four previous courses in sociology, including 48-101, before taking these classes. Contents of courses changes each semester. Contact Department or instructor for more information.

48-402 SOCIOLOGICAL RESEARCH

How do sociologists know what they are talking about? Students will read works of social researchers and carry out projects of their own. Methods include surveys, interviews, participant observation, content analysis, secondary sources, or some combination of these methods. Required for sociology majors. 3 cr.

48-404 FIELD PLACEMENT

This course provides students with the opportunity to directly observe and participate in the operation of a social service organization. Prerequisite 48-350, and permission of instructor. Sperounis. 3 cr.

48-421 SEMINAR ON THE FAMILY

A study of family structures and gender roles in various human societies. Prerequisite 48-101 plus either 48-231 or 48-241. Brown, Das. 3 cr.

48-465 SEMINAR IN THE SOCIOLOGY OF HEALTH AND HEALTH CARE

A seminar that focuses on particular topics of interest to students and the instructor such as health, health care, and government policy; prison health, nursing homes; the health industry, medical professions; health and health care in other countries; and psychiatry and health. Prerequisite: Permission of instructor. 3 cr.

48-466 SEMINAR IN CLASS, STATUS AND POWER

It emphasizes the impact of class, status, and power relationships on the social organization of past and present societies. Special attention is focused on processes for redistributing privileges and rewards in society. Prerequisite: 48-341, 256 or permission of instructor. 3 cr.

48-468 SELECTED TOPICS

This seminar will concentrate on one area of sociology each time it is taught. See department for more information. 3 cr.

48-479 SENIOR SEMINAR

The class will read and analyze books on a variety of subjects. Permission of instructor. Brown. 3 cr.

Directed Studies

Directed study courses are available only to majors in sociology and may be elected provided that (1) the material to be covered is not available in any course offered during the semester in which a directed study course is contemplated, (2) instructors are willing to undertake a directed course, and (3) no more than 9 credits in the major field are acquired in directed study courses.

48-491 DIRECTED STUDIES IN SOCIOLOGY

The student, through regular and frequent consultation with his instructor, develops a course of directed reading in sociology and defines a problem for individual research. Prerequisite: Permission of instructor. 3 cr.

48-495 ADVANCED TUTORIAL IN SOCIOLOGY

A program of directed study which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation in the student's major discipline. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of instructor. 3 cr.

Practicum

48-496 PRACTICUM EXPERIENCE

A program of campus and/or off-campus experiences for sociology majors only. Specific requirements will vary, depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated to a maximum of 9 credits. Students will be graded "satisfactory" or "unsatisfactory". The practicum experiences may not be substituted for a required course in the major. Prerequisite: Permission of chairperson. 3 cr.

INTERDISCIPLINARY PROGRAMS AND MINORS

Classical Civilization

Course work for a minor area of study in classical civilization is selected in consultation with Dr. Christos Bentas of the history department from the following disciplines: art, classics, English, history, Greek, Latin, philosophy and Western Cultural Heritage. Course work for the classical civilization minor must be distributed in three areas with at least 9 hours in one area, 6 hours in a second area, and 3 hours in a third area. Although courses in Latin or Greek are not required for the minor, students are urged to complete at least 6 hours of the minor in a classical language at the intermediate level. At least 6 hours must be taken in course work at the 300 level or above.

Cognitive Science

A minor in Cognitive Science is designed primarily for the Electrical Engineering or Computer Science student who is interested in artificial intelligence. This interdisciplinary minor exposes the student to three methods of stu-

dying mental processes: philosophic and linguistic analysis, psychological experimentation, and computer simulation. Courses in each of these three areas of study are listed below. The minor consists of 18-24 credits: at least 6 credits from each area and at least 6 credits at the 300 level or higher. Technical electives and approved electives may be used to fulfill the Area C requirement. Core courses in Area A or Area B may be applied both to the university core requirement and to the cognitive science minor. Some prerequisites for the following courses in the cognitive science minor may be waived, with consent of the instructor.

- | | |
|--|---|
| A. Philosophic and Linguistic Analyses of Cognition | 45-305 Language, Signs, and Symbols |
| 42-308 Analysis of Modern English | 45-311 Philosophy of Mind |
| 42-431 Contemporary Linguistic Theory | 45-312 Philosophy of Science |
| 45-285 Philosophy of the Creative Imagination | |
| 45-301 Theory of Knowledge | |
| B. Psychological Experimentation on Cognition | 47-377 Research Lab in Experimental Psyc: |
| 47-276 Theories of Learning | Cognitive Psychology |
| 47-277 Sensation and Perception | 47-378 Research Lab in Social Behavior |
| 47-278 Cognitive Psychology of Language and Thinking | 47-477 Seminar: Contemporary Trends/Cognition |
| 47-376 Research Lab in Experimental Psyc: Sensation & Perception | |
| C. Computer Simulations of Cognition | 92-465 Formal Languages |
| 16-521 Automata Studies | 92-466 Theory of Computation |
| 92-459 Artificial Intelligence | |

Course work in the minor in Cognitive Science is selected in consultation with Dr. Robert Kunzendorf of the Psychology Dept.

Latin American Studies

Courses for a minor field in Latin American studies are selected in consultation with Professor George Luter of the history department from the list below. *Six credits at the "200" level or above are required for the Spanish language component.* Course work for the Latin American Studies minor must meet the following distribution requirement:

Spanish language	6 credits
History/Economics	6-9 credits
Latin American literature	6-9 credits

At least 6 hours in non-language courses must be taken in course work at the "300" level or above.

43-205 Ancient American Civilization	64-319 Topics in Latin American Economics
43-206 Latin American Civilization	54-211 Intermediate Conversational Spanish I
43-245 Mexico and the Caribbean	54-212 Intermediate Conversational Spanish II
43-280 Inter-American Relations	54-222 Reading & Conversing in Spanish I
43-309 Cultural History of Latin America	54-223 Reading & Conversing in Spanish II
43-312 Contemporary Latin America	

Other appropriate Spanish language courses may be substituted with the approval of Professor Luter.

54-302 Introduction to Latin American Literature	54-416 The Latin American Novel
54-401 Selected Authors (Latin American)	54-315 Interamerican Cultural Expression
54-412 The Short Story in Latin America	

Students majoring in Spanish or Modern Languages (with Spanish option) may elect the Latin American studies minor, but may not offer any course in Spanish language or literature (prefix: 54-) as part of the 18-24 semester credits.

Elective Concentration in Business Skills

The elective concentration described below is NOT a minor area of study. It is a sequence of courses designed to provide an appropriate background for liberal arts graduates who desire either to enroll in a graduate program leading to a Master of Business Administration (MBA) degree or to enter directly into business or industry on the completion of their undergraduate study. The program is designed to emphasize skills and course background that are required by MBA degree programs and that are most sought after by employers in business and industry. Students who elect this option are strongly advised to complete the program (24 credits) as specified.

Courses:

92-121 Pre-Calculus Mathematics
92-122 Differential Calculus
92-201 Integral Calculus
92-242 BASIC Programming with Business Applications

64-201 Economics I (Microeconomics)
64-202 Economics II (Macroeconomics)
64-211 Statistics for Business and Economics I
64-212 Statistics for Business and Economics II

Strongly recommended as collateral courses are 47-101 Introduction to Psychology, and 48-101 Introduction to Sociology.

Technology, Society and Human Values

Shirley Kolack (Sociology), Coordinator.

The Interdisciplinary minor in Technology, Society, and Values consist of 18-24 credits of course work. At least 6 credits must be selected from courses which are numbered 300 or above.

The courses offered in this Program are interdisciplinary in their content and structure and are designed to explore a topic in greater depth and from broader perspectives than is ordinarily possible in other courses. Many courses are team taught by faculty chosen from various academic departments and colleges within the University. Courses emphasize the sources (scientific, philosophical and historical) of the period studied and the interrelationship between technology and human values.

Staff

Professors: Adolph Baker (Physics), Charles Carroll (History), Shirley Kolack (Sociology), Joseph Lipchitz (History), James Phelps (Nuclear Engineering), Joan Rothschild (Political Science).

Associate Professors: Jack Apfelbaum (Industrial Technology), Carol Brown (Sociology), Jonathan Liebowitz (History), John MacDougall (Sociology), Karl Sladek (Chemical Engineering).

Assistant Professors: Judith Pastore (English), Mitra Das (Sociology).

Technology, Society and Human Values (Course Prefix: 59)

59-203 TECHNOLOGY AND HUMAN VALUES I

These courses will explore the various facets of humanity's relationship to technology throughout the course of history as well as in contemporary culture. By reflecting upon the mechanisms, context and consequences of technological growth, it should be possible to discern the ways in which changes in the technological environment effect revisions in a human being's self-image and values and how, in turn, the frameworks of meaning generated by the human spirit can serve to reorganize technological structures, infuse them with new values, and create novel dimensions to living. Technology and Human Values I deals with technology and the transformation of values during significant historical periods (e.g., the Middle Ages, the Scientific Revolution). Technology and Human Values II focuses on contemporary challenges, such as the impact of technology on the modern family. The members of the teaching team are humanists, scientists and engineers. Staff. 3 cr.

59-204 TECHNOLOGY AND HUMAN VALUES II

A continuation of 59-203. Staff.

3 cr.

59-288 INDUSTRIAL LOWELL: DECLINE AND REBIRTH

An interdisciplinary course dealing with the growth, decline and rebirth of Lowell, Massachusetts, from its inception as the first planned industrial city to present time. This course is designed to compliment the establishment of the first Urban National Park in Lowell. This course is team-taught by an economist, engineer, historian and sociologist. The major topics covered are "The Process of Economic Growth and Decline", The Pre-1833 Period, "The Golden Age 1822-1860", "Maturity, Decline and Rebirth 1861-Present", and "The State Heritage Park and The Lowell National Historical Park: Catalysts for Economic Cultural and Social Revival". Professors Diamond, Carroll, Kolack and Das. 3 cr.

59-301 PROJECT SEMINAR IN A SYSTEMS APPROACH TO TECHNOLOGY

(Prerequisite: This course is for juniors and seniors who have had one or both semesters of Technology and Human Values.) The seminar will provide students with the opportunity to pursue in depth one or more of the many questions examined in the Technology and Human Values core courses. Students will explore problem areas in one or more dimensions such as social, environmental, ethical and technical. Overall, the projects undertaken will examine various links between technology and society. Students will have the excitement of actively

participating in the research process and their data-gathering will culminate in final written reports. The course will be staffed by an interdisciplinary team composed of a humanist and a scientist and/or engineer. Each member of the team will bring his or her expertise to the formulation, development and implementation of student projects. Professors Kolack and Baker. 3 cr.

59-302 PROJECT SEMINAR IN A SYSTEMS APPROACH TO TECHNOLOGY

A continuation of 59-301. Professors and Kolack and Baker. 3 cr.

59-305 THE ENGINEER IN SOCIETY

The class will examine from an interdisciplinary perspective the role of the engineer in society. How has this role changed? What can be expected for the future? The engineering personality, engineers in industry, ethics and engineering are some of the subjects to be covered. The format of the class will encourage discussion of the issues. Each student will prepare a substantial report on a topic of personal interest. Professors Apfelbaum and Liebowitz. 3 cr.

59-308 TECHNOLOGY AND GENDER

An analysis of gender perspectives of technology, focusing on invention, work, values, and new technologies. Rothschild. 3 cr.

59-350 SEMINAR IN TECHNOLOGY AND HUMAN VALUES

Students will undertake projects examining the links between technology and society. Prerequisite: 59-203 or 59-204. Kolack. 3 cr.

Western Cultural Heritage

Veda Cobb-Stevens (Philosophy), Coordinator.

The interdisciplinary minor in Western Cultural Heritage consists of 18-24 credits of course work. At least 6 credits must be selected from courses which are numbered 300 or above.

The courses offered in this program are interdisciplinary in their content and structure and are designed to explore a topic in greater depth and from broader perspectives than is ordinarily possible in other courses. Many courses are team taught by faculty chosen from various academic departments and colleges within the University. Courses emphasize the sources (artistic, literary, philosophical and historical) of the period studied and focus on the aspirations and achievements of our own civilization.

Staff:

Professors: Mario Aste (Language), Joseph Garreau (Language), Robert Stein (English), Roger Wiehe (English), Joseph Zaitchick (English).

Associate Professors: Peter Blewett (History), Veda Cobb-Stevens (Philosophy), Richard Derry (History).

Assistant Professors: Liana Cheney (Art), Martha McGowan (English).

Western Cultural Heritage (Course Prefix: 59)

59-205 VIEWS OF THE HUMAN SITUATION IN WESTERN CULTURE I

This course is designed to address some of the important questions of human existence through a close study of representative literary, philosophical, and religious texts from ancient times to the present. Students will read and evaluate essays, plays, poems, and fiction that deal with these perennial themes. The first semester will focus on the Problem of Evil, Self and Society, and Freedom and Fate. The second semester will be concerned with the Search for Knowledge, The Nature of Man, and the Experience of Love. Professor J. Zaitchick. 3 cr.

59-206 VIEWS OF THE HUMAN SITUATION IN WESTERN CULTURE II

A continuation of 59-205. May be taken independently of Views of the Human Situation in Western Culture I. Professor J. Zaitchick. 3 cr.

59-208 WESTERN CULTURAL HERITAGE I

The actual development of a culture proceeds on many levels at once: the art, literature, philosophy and social structure of a given historical period evolve together, interact with one another, and eventually give rise to a new era. These courses are designed to capture the richness of the various periods of Western civilization, to discern

networks of dependency and influence among the diverse aspects of epoch's culture and to trace lines of continuity between one age and another. The first semester will treat the period from Near Eastern Civilization to the Protestant Reformation; the second semester will focus on developments from the seventeenth through the twentieth centuries. 3 cr.

59-209 WESTERN CULTURAL HERITAGE II

A continuation of 59-208. May be taken independently of Western Cultural Heritage I. Staff. 3 cr.

59-310 THE CULTURE OF ANCIENT GREECE

No one term can capture completely the richness of Greek culture, but there is one which comes closer than any other: TO KALON, which means nobility, goodness, or beauty. Taking this term as a guideline, we will explore the many facets of Greek culture by focusing upon social and political structures, the development of moral consciousness, and the appreciation of beauty. These issues will be approached through the examination of developments in Greek art as well as through reflection upon works by Greek poets, dramatists, philosophers and historians. Professors Blewett, Cheney, Cobb-Stevens. 3 cr.

59-314 SOCIETY AND CULTURE IN THE EARLY MIDDLE AGES

This course will explore the political, social and cultural transformation which took place in Europe during the five centuries following the collapse of the Western Roman Empire. Drawing from historical, literary, linguistic and artistic sources, the classes and lectures will focus on the classical, Christian, Germanic and Celtic contributions to the new society and culture that was being created in Europe at this time. Special attention and the cultivation of letters. A major aim of the course is to make the student aware of how this formative period of the early Middle Ages can help us understand the full achievements of medieval society and culture at its zenith and, ultimately, the European civilization to which it gave birth. Professors Aste, Derry. 3 cr.

59-320 SIXTEENTH CENTURY ITALIAN CULTURE

This course examines the literary, artistic and musical works of the Italian Renaissance in the sixteenth century, focusing on the theories governing the creation of these works, their backgrounds in classicism, their interrelationship as a part of the humanistic movement, changes in modes of representation and the emergence of new genres. Attention will be given to the socio-historical conditions leading to development of the "universal man", the role of the Italian courts and academies in fostering the arts, and to the historical development of the Reformation and Counter-Reformation. Professors Cheney and Wiehe. 3 cr.

59-330 SEVENTEENTH CENTURY EUROPEAN CULTURE

The theme of this course will be: views of the Individual and the Emergence of the Modern State. Concentrating primarily on France, England and the Netherlands, the course will examine both the political and social organizations of these emergent nations, as well as the various views of human nature which are expressed in their literature, philosophy and art. One of the principle goals of the course is to discern how the art forms and ideas of individuals influence and are influenced by the social and political structures around them. Professors Blewett, Cheney, Cobb-Stevens. 3 cr.

Women's Studies

Faculty Committee

Joan Rothschild, Coordinator (Political Science)
Judith Anderson (English)
Mary Blewett (History)
Liana Cheney (Art)
Mitra Das (Sociology)
Alma Espinosa (Music)

Marianne Knowlton (English)
Martha McGowan (English)
Barbara Miliaras (English)
Ann Mulvey (Psychology)
Mary Walsh (Psychology)

A minor in women's studies consists of 18-24 credits in cross-cultural and multidisciplinary courses, six credits of which must be at the 300 level or above. Women's studies affords an opportunity to develop an understanding of issues specific to the status and condition of women and to gain critical faculties and tools of analysis to relate these issues to the disciplines, human behavior, and social institutions. The following courses have been approved for the minor in Women's Studies:

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|---|--|
| 42-240 Literature and Women | 46-250 Women, Power, and Politics |
| 42-241 Women in Film | 47-335 Psychology and Women |
| 52-242 The Heroine in Modern Fiction | 47-473 Seminar: Social Psychology on Women |
| 42-243 Contemporary Women Writers | 48-231 Sociology of the Family |
| 42-257 The Family in Literature | 48-241 Women in Society |
| 42-345 Female English Novelists | 48-421 Seminar on the Family |
| 42-383 Regional Perspectives in Women's Literature | 58-340 Women and Art |
| 43-268 History of the Family and Childhood in the United States | 59-308 Technology and Gender |
| 43-270 Women in American History | 74-166 Women in Music |
| 43-274 The Family in Western Society | 82-351 Human Sexuality |
| 43-307 Men, Women, and Work | |

Additional courses on women's studies topics may be approved for the minor upon application to the Women's Studies Committee.

FACULTY OF THE COLLEGE OF LIBERAL ARTS

DEAN OF THE COLLEGE

Patricia A. Goler, A.B.; A.M.; Ph.D.; L.L.D. (Hon.); D.H.L. (Hon.)

ASSISTANT DEAN

Richard L. Derry, A.B., A.M.

CHAIRPERSONS

Department Chairpersons

Mario Aste, A.B.; A.M.; Ph.D.; Languages

Carol Brown, B.A., M.A.; Ph.D.; Sociology

Veda A. Cobb-Stevens, A.B.; A.M.; Ph.D.; Philosophy

Frederic L. Faudie, A.B.; A.M.; M.F.A.; Art

Frederick P. Lewis, A.B.; J.D.; Ph.D.; History and Political Science

Gerard O'Connor, A.B.; A.M.; Ph.D.; English

Allie Scruggs, B.S.; Ed.M.; Ed.D.; Psychology

Program Directors

Charles F. Carroll, A.B.; A.M.; Ph.D.; Coordinator, American Studies

Joyce Denning, A.B.; A.M.; Director, Second Chance Program

Joseph W. Lipchitz, B.A.; M.A.; Ph.D.; Coordinator, Law & Justice

RESIDENT FACULTY

William M. Aiken, Associate Professor, English; B.A., Trinity College; A.M., Harvard University; Ph.D., Boston University.

Mario Aste, Associate Professor, Languages; A.B., University of Turin; A.M., Ph.D., Catholic University.

Harald C. Bakken, Assistant Professor, History; A.B., University of Minnesota; A.M., Ph.D., Harvard University.

Christos J. Bantas, Professor, History & Classics; A.B., Ed.M., Boston University; A.M., Ph.D., Tufts University.

Dean J. Bergeron, Assistant Professor, History & Political Science, A.B., St. Michael's College; A.M., Villanova University.

Donald R. Berry, Assistant Professor, English; Coordinator, Continuing Education Program; B.A., M.A., Baylor University.

Mary Blewett, Professor, History; A.B., A.M., Ph.D., University of Missouri.

Peter Blewett, Associate Professor, History; A.B., Northeastern University; A.M., Ph.D., Boston College.

Robert Bousquet, Associate Professor, French; A.B., M.Mus., Catholic University; Ph.D., Georgetown University.

Carol Brown, Associate Professor, Sociology; B.A., Bucknell University; M.A., Ph.D., Columbia University.

Janet Burke, Associate Professor, Psychology; B.S., M.Ed., Ph.D., Boston College.

William C. Burto, Professor Emeritus, English; A.B., Colgate University; A.M., Ph.D., Harvard University.

Eva Buzawa, Assistant Professor, Law & Justice; B.A., University of Rochester, M.S., Ph.D., Michigan State University.

Joan Cannon, Assistant Professor, Psychology; B.A., St. Mary's College, M.Ed., Boston University, Ed.D., Clark University.

Charles F. Carroll, Professor, History; A.B., A.M., Boston College, Ph.D., Brown University.

Liana Cheney, Assistant Professor, Art; A.B., A.M., University of Miami; Ph.D., Boston University.

Leon Chorbajian, Assistant Professor, Sociology; A.B., Temple University; A.M., University of Michigan; Ph.D., Brandeis University.

James W. Coates, Assistant Professor, Art; B.F.A., University of South Carolina; M.F.A., Clemson University.

Veda A. Cobb-Stevens, Assistant Professor, Philosophy; A.B., University of Kentucky; A.M., Ph.D., Boston College.

Pilar Concejo, Assistant Professor, Spanish; Licenciatura en Filología Hispanica, University of Salamanca (Spain), M.A., Ph.D., University of Cincinnati.

Andrea Corbett, Assistant Professor, English; B.A. University of New Hampshire; M.A., Vanderbilt University.

William Coughlin, Associate Professor, English; B.S., Lowell State College; A.M., Middlebury College, Ed.D., University of Massachusetts, Amherst.

Arthur T. Dabilis, Assistant Professor, English; A.B., Suffolk University; M.A., Northeastern University.

Mitra Das, Assistant Professor, Sociology, A.B., A.M., University of Rajasthan; Ph.D., University of Massachusetts.

Joyce Denning, Assistant Professor, Political Science; A.B. Tufts University A.M., Duke University.

Richard L. Derry, Associate Professor, History; A.B., Holy Cross College; A.M., Boston College.

Robert J. DeYoung, Assistant Professor, English; B.A., M.A., New York University.

Barbara Dowd, Assistant Professor, Political Science; A.B., Mount Holyoke College; A.M., Fordham University.

John B. Duff, Professor, History; B.S., Fordham University; M.A., Seton Hall University; Ph.D., Columbia University.

Frederic L. Faudie, Assistant Professor, Art; A.B., Cornell University; A.M., University of Iowa; M.F.A., Syracuse University.

Richard R. Foster, Assistant Professor, English; B.A., Louisiana State University; M.A., University of Southern California.

Robert J. Foy, Professor, English; B.S., Plymouth State College of U.N.H.; M.A., Ed.S., George Peabody College; Ed.M., Ed.D., Harvard University.

Arthur Friedman, Assistant Professor, English; A.B., City College of New York; A.M., Boston University.

William Gallagher, Instructor, English; B.A., University of Massachusetts, M.Ed., Lowell State College.

Joseph Garreau, Professor, French; A.B., University of Poitiers; S.T.L., College Saint-Albert de Louvain; A.M., Ph.D., Boston College.

Patricia A. Goler, Professor, History; A.B., Regis College; A.M., Ph.D., Boston College; L.L.D. (Hon) Regis College; D.H.L. (Hon) Emmanuel College.

June Gonsalves, Assistant Professor, Criminal Justice; B.A., J.D., Northeastern University.

Robert Griffin, Assistant Professor, English; B.S., Salem State College; M.A., Tufts University.

Robert Griffith, Assistant Professor, Art; B.S. Ed., Massachusetts College of Art; M.F.A., Pratt Institute.

Herbert Haber, Associate Professor, English; A.B., Brooklyn College, A.M., University of Chicago; Ph.D., Brandeis University.

William S. Harrison, Assistant Professor, Sociology; A.B., Harvard University.

Jon C. Hellstedt, Associate Professor, Psychology; A.B., Augustana College; B.D., Yale University; Ph.D., Boston University.

J. Hell Hernandez, Associate Professor, Spanish; A.B., University Javeriana (Bogota); A.M., Ph.D., Catholic University.

William R. Hersey, Assistant Professor, English; B.S., Lowell State College; M.A., Boston College.

Lester B. Hudson, Assistant Professor, Psychology; A.B., M.A., Boston University.

Kathleen D. Hulbert, Assistant Professor, Psychology; A.B., Northwestern University; Ed.M., Ed.D., Boston University; C.A.G.S., University of New Hampshire.

Robert Innis, Professor, Philosophy; A.B., St. Mary's College; S.T.B., Gregorian University; A.M., Ph.D., Fordham University.
 Charles E. Jarvis, Professor, English; B.S., M.A., Boston University.
 Renee Kasinsky, Associate Professor, Criminal Justice; B.A., M.A., Ph.D., University of California at Berkeley.
 Marianne H. Knowlton, Assistant Professor, English; B.A., Smith College; M.A., Tufts University.
 Shirley Kolack, Professor, Sociology; B.S., A.M., Ph.D., Boston University.
 Mary D. Kramer, Assistant Professor, English; A.B., University of Wisconsin A.M., Ph.D., University of Kansas.
 Robert Kunzendorf, Assistant Professor, Psychology; B.A., Yale University; M.A., Ph.D., University of Virginia.
 David A. Landman, Assistant Professor, English; A.B., New York University; A.M., Boston University.
 David Landrigan, Assistant Professor, Psychology; B.S., Tufts University; M.A., Ph.D., University of New Hampshire.
 Clifford L. Lewis, Associate Professor, American Studies & English; A.B., Union College; A.M., SUNY, Buffalo; Ph.D., University of Texas.
 Frederick P. Lewis, Associate Professor, Political Science; A.B., Columbia College; J.D., Harvard University; Ph.D., Tufts University.
 Jonathan J. Leibowitz, Assistant Professor, History; A.B., Columbia University; M.A., Ph.D., University of California, Berkeley.
 Alan Lincoln, Assistant Professor, Criminal Justice; B.S., Michigan State; M.S., M.A., Ph.D., University of Massachusetts.
 Joseph W. Lipchitz, Professor, History; B.A., M.A., University of Massachusetts; Ph.D., Case Western Reserve University.
 George W. Luter, Assistant Professor, History; B.S., A.M., Xavier University.
 John MacDougall, Assistant Professor, Sociology; B.A., Oxford University; Ph.D., Harvard University.
 Charlotte Mandell, Assistant Professor, Psychology; B.A., Brooklyn College; M.A., Ph.D., Columbia University.
 Donald J. Matheisen, Associate Professor, History; B.A., A.M., Ph.D., University of Minnesota.
 John J. McCaffrey, Assistant Professor, English; A.B., Suffolk University A.M., Tufts University.
 Martha McGowan, Assistant Professor, English; A.B., Brandeis University; A.M., Boston College; Ph.D., Boston University.
 Eugene Mellican, Assistant Professor, Philosophy; B.A., M.A., Ph.D., Loyola University.
 John M. Mendicco, Associate Professor, Spanish; A.B., A.T.L., University of Salamanca; A.M., Ph.D., Catholic University.
 Barbara Miliaras, Assistant Professor, English; A.B., Ed.M., Boston University.
 Arthur Miller, Professor, History & Philosophy; B.S., City College of New York; Ph.D., Massachusetts Institute of Technology.
 Avalon N. Minton, Assistant Professor, Political Science; A.B., Wake Forest University; A.M., Brown University.
 Howard K. Moore, Professor Emeritus, English; Coordinator of Instructional Development; A.B., A.M., Boston University; M.L.S., Simmons College; Ph.D., Boston University.
 William L. Mulcahy, Jr., Assistant Professor, Spanish; B.A., Harvard University; M.Ed., Salem State College.
 Charles Nikitopoulos, Assistant Professor, Psychology; A.B. Suffolk University; A.M., New School for Social Research; Ph.D., Boston College.
 William G. Nowlin, Jr., Assistant Professor, Political Science; B.A., Ph.D., Tufts University; M.A., University of Chicago.
 Marie O'Brien, Assistant Professor, Sociology; B.S., M.A., Ph.D., Boston University.
 Gerard W. O'Connor, Professor, English; A.B., Harvard University; A.M., Ph.D., Boston University.
 Leo Panas, Associate Professor, Art; B.S.Ed., Massachusetts College of Art, Ed.M., Fitchburg State College.
 Judith Pastore, Assistant Professor, English; A.B., Rutgers University; A.M., Radcliffe College; Ph.D., Harvard University.
 Hai B. Pho, Assistant Professor, Political Science; A.B., Boston College; A.M., Rutgers University; A.M., Ph.D., Boston University.
 Brenda Pinardi, Associate Professor, Art; B.S.Ed., Massachusetts College of Art; M.F.A., Rhode Island College of Design.
 Carlton Plummer, Associate Professor, Art; B.S.Ed., Massachusetts College of Art; M.F.A., Boston University.
 Miriam D. Price, Assistant Professor, History; A.B., Smith College; M.A., Boston University.
 John J. Riley, Associate Professor, English; A.B., M.A., Boston University; Ph.D., Tufts University.
 William H. Roberts, Assistant Professor, English; A.B., B.S., A.M., Ph.D., Ohio State University.
 Joan A. Rothschild, Professor, Political Science; A.B., Cornell University; M.A., Ph.D., New York University.
 Charles J. Ryan, Assistant Professor, English; B.A., University of Connecticut; M.A., University of Massachusetts.
 Herlinda Ch.Saitz, Assistant Professor, Spanish; Licenciatura, University of Panama; Diplomas de Especializacion, Seminario Andres Bello, Colombia.
 Deborah Schildkraut, Associate Professor, Psychology; B.A., Chatham College; M.S., Ph.D., University of Miami.
 Allie Scruggs, Professor, Psychology; B.S., Ed.M., Ed.D., Boston University.
 Gloria C. Seeman, Assistant Professor, Psychology; A.B., City College of New York; M.S., Ph.D., Syracuse University.
 John J. Shea, Associate Professor, History; A.B., Harvard College; A.M., Creighton University; Ph.D., Boston University.
 Richard A. Siegel, Associate Professor, Psychology; A.B., Harvard College; M.S., Yale University; Ph.D., Boston University.
 Linda Silka, Assistant Professor, Psychology; B.S., Oklahoma State University; M.A., Ph.D., Kansas University.
 P. Christopher Smith, Professor, Philosophy; A.B., A.M., Columbia University; Ph.D., University of Heidelberg.
 Frederick Sperounis, Assistant Professor, Sociology; B.S., Ed., Salem State College; M.A., Ph.D., Brandeis University.
 Robert A. Stein, Professor, English; A.B., Clark University; A.M., Ph.D., Brandeis University.
 Francesca Tillona, Associate Professor, English; B.A., Brooklyn College; A.M., Ph.D., Boston University.
 Gardner Tillson, Assistant Professor, English; A.B., Tufts University; A.M., Pennsylvania State University.
 Anthony C. Turrisi, Assistant Professor, English; B.S., Massachusetts Institute of Technology; M.A., University of Wisconsin.
 Francis R. Walsh, Professor, History; B.S., M.A., Ph.D., Boston University.
 Mary Roth Walsh, Associate Professor, American Studies & Psychology; B.S., Mount Mary College; M.S., Cornell University; Ph.D., Boston University.
 Joseph W. Waterman, Associate Professor, Psychology; B.S., University of Vermont; M.B.A., Boston University; Professional Diploma, (Guidance), University of Connecticut.
 Robert J. Whelan, Assistant Professor, German; B.A., Boston College; M.A., Catholic University of America.
 Roger E. Wiehe, Professor, English; B.A., Yale University; M.A., University of Illinois; Ph.D., Columbia University.
 Joseph Zaitchik, Professor, English; A.B., Suffolk University; A.M., Ph.D., Boston University.

COLLEGE OF PURE AND APPLIED SCIENCES

Joseph C. Salamone, Dean
F. Raymond Hardy, Assistant Dean

Motivation for the pursuit of scientific and mathematical inquiry stems from two basic human characteristics. One is the quest for knowledge for its own sake in order to understand the workings of our universe, and the other is the desire to enlist the investigative techniques of science and mathematics in the service of humanity in order to improve the quality of life. These two aspects of science, one of which allows us to properly define the energies and matter of our reality and the other of which is applied to the task of freeing our lives from disease and deprivation, are integrated and harmonious activities—although from time to time the relative emphasis placed by society on each activity may change. Until the Industrial Revolution, the cultural side of science was in the ascendance. Since this time, a greater society awareness has been placed on the practical application of the scientific discovery process: and during the past century science has so enriched our lives that it is difficult to conceive of a truly educated person who has not had exposure to some of the concepts and methodologies of science.

Undergraduate programs in the pure and applied sciences serve the preprofessional needs of students who desire to enter such professions as medicine and provide excellent preparation for graduate studies in the several pure and applied sciences as well as for science-oriented careers in business, government, and industry. Regardless of the student's career goals, however, the program of study which an individual may elect should have universal perspective and significance as well as particular depth and comprehension. It should provide experiences for developing competency in using the modes of thought characteristic of the major areas of scientific knowledge as well as providing the opportunity for developing a thorough understanding of at least one scientific area. To the degree that undergraduate education in the pure and applied sciences is the basis for further graduate training, for career preparation, or for the meaningful perception, integration and understanding of life experiences, it must be both general and specific and must be determined not only by such personal considerations as individual interests, demands, and competencies but also by such impersonal factors as the spectrum of scientific knowledge and the nature of particular scientific disciplines.

OBJECTIVES OF THE COLLEGE OF PURE AND APPLIED SCIENCES

The educational objectives of the College of Pure and Applied Sciences are to contribute to the advancement of science, to provide support and service courses for non-science majors, to provide the basic understanding of scientific concepts and methodologies which is an essential ingredient of a liberal education, and to prepare students for entry into the various science-related professions.

The curricula of the College seek to increase the capacities of students who major in the pure and applied sciences for understanding themselves and the world in which they live, especially as these capacities relate to the modes of thought which are characteristic of the major areas of scientific knowledge. To accomplish this objective, the several curricula are organized to foster fundamental communication skills in language and mathematics, to promote appreciation and comprehension of man's cultural, social, physical, and biological environment through exposure to the major areas of human knowledge, to develop a thorough understanding of the scientific method upon which all scientific endeavor is based, and to provide the special and technical knowledge which accrues from a penetrating study of a particular discipline in the pure and applied sciences.

COLLEGE ORGANIZATION & GOVERNANCE

The College of Pure and Applied Science is organized into six departments and is administered by a dean, who is assisted by an all-college council. The six departments are responsible for developing course offerings and programs of studies. Although the faculty of the College has overall responsibility for all academic policies of the College, the Undergraduate Academic Standards and Curriculum Committee is responsible for enforcing the academic standards of the pure and applied sciences faculty and also serves as a review body for suspended students seeking readmission with probationary status.

Undergraduate Academic Standards and Curriculum Committee

Dr. Richard Gore, Earth Sciences
Prof. Judith Kelley, Chemistry
Dr. Arthur Mittler, Physics and Applied Physics, Chairperson
Prof. Paul Protopapas, Biological Sciences
Prof. Charles Steele Jr., Computer Science
Dr. Joyce W. Williams, Mathematics

College Council

Dr. Thomas Costello, Computer Science
Prof. Alan W. Doerr, Mathematics
Dr. Zoltan Fried, Physics and Applied Physics
Dr. Stuart Clough, Chemistry
Dr. Arnold L. O'Brien, Earth Sciences
Dr. Thaddeus V. Osmolski, Biological Sciences
Dr. Joseph C. Salamone, Dean
Prof. F. Raymond Hardy, Ass't Dean

BACCALAUREATE DEGREE PROGRAMS

The College of Pure and Applied Science offers undergraduate programs leading to the Bachelor of Arts degree and to the Bachelor of Science degree. Students who matriculate for the degree of Bachelor of Arts may pursue majors in chemistry or environmental sciences. Students who matriculate for the degree of Bachelor of Science may pursue majors in biological sciences, chemistry, computer science, environmental sciences (geology option), mathematics, meteorology, physics, and radiological health physics. Students should consult the *Graduate School Catalogue* for information concerning masters programs in biological sciences, chemistry, mathematics, physics and applied physics, polymer science, radiological sciences and protection, and doctoral programs in chemistry, physics and applied physics.

In addition to satisfying general University requirements for baccalaureate degrees as are defined elsewhere in this publication under the heading "Academic Policies: Baccalaureate Studies," students who matriculate for degrees in the College of Pure & Applied Sciences also must complete a specific minimum number of courses and credits in the College of Pure & Applied Sciences. These College requirements are described below. Except as specified by college and program restrictions, students are permitted to elect any course for which they can satisfy prerequisite requirements in fulfilling an unrestricted elective requirement. However, in order to designate courses from other colleges of the University as science or mathematics courses, students must petition the Undergraduate Curriculum Committee of the College of Pure & Applied Sciences.

Some degree candidates in the College of Pure & Applied Sciences may be interested in pursuing a second major which is offered by the College or another college of the University. Students who wish to elect a second major should consult the relevant policies which appear elsewhere in this publication under the heading "Academic Policies: Major Field Requirements." Students who elect academic majors in more than one college are candidates for one degree only, and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary at the time they make a declaration of second major by filing for inter-collegiate transfer. Accordingly, a student who pursues academic majors in two colleges is subject to all degree requirements as specified by the college of his or her initial major and is subject only to major course requirements (including any collateral and prerequisite courses for the major) as specified by the department of his or her second major..

Students who are interested in satisfying degree requirements in the College of Pure & Applied Sciences and who also wish to complete professional degree programs in other colleges should inquire if dual degree programs can be authorized. (Cf. "Academic Policies: Dual Degree Programs.")

Minor areas of study which are offered by the College of Pure & Applied Sciences are as follows: biological sciences, chemistry, geology, mathematics, physics and radiological health physics. College majors may wish to consider these minors, other minors which are offered by the College of Liberal Arts, the College of Management Science, College of Music, and specialized course sequences of the College of Engineering. All minor programs of the University require 18-24 credits, six of which must be at the 300 course level or above.

Bachelor of Arts Degree

Curricula leading to the Bachelor of Arts degree are designed to provide a broad, comprehensive education and generally provide more liberal options than are permitted within Bachelor of Science programs. All Bachelor of Arts programs which are offered by the College of Pure & Applied Sciences require, as a minimum, 60 credits and 15 courses in science and mathematics offerings of the College. At least three courses are required in mathematics and four courses are required in sciences which are exclusive of the student's major program. Bachelor of Arts programs of the College also require, as a minimum, 45 credits and 15 courses from the offerings of the College

of Liberal Arts, the College of Music, and the economics offerings of the College of Management Science. For University policies concerning majors presented for the Bachelor of Arts degree, see policies which appear elsewhere in this publication under the heading "Academic Policies: Major Field Requirements."

Bachelor of Science Degree

The Bachelor of Science degree is designed to provide students with a specialized education in one or more of the basic sciences. Specialized Bachelor of Science curricula which are offered in areas of the pure and applied sciences and mathematics provide opportunities for major and minor program options but afford greater opportunities for major specialization than are permitted in comparable Bachelor of Arts curricula.

All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the College of Pure & Applied Sciences. At least three courses are required in mathematics beyond college algebra and must include two calculus courses and one additional mathematics elective.

Four science lecture courses with corequisite laboratories are required (two from each of two departments).

For University policies concerning majors presented for the Bachelor of Science degree, see policies which appear elsewhere in this publication under the heading "Academic Policies: Major Field Requirements."

GENERAL COLLEGE REQUIREMENTS

In order to qualify for a baccalaureate degree offered by the College of Pure and Applied Sciences, undergraduates must comply with the University Core Requirements, must conform to the rules of the College of Pure and Applied Sciences which govern degree and major studies for such degrees, and must earn 2.00 averages in their major fields by the end of their senior year.

Language Proficiency Requirement

Although the College of Pure and Applied Sciences does not require language proficiency, each department has the prerogative of specifying a level of language proficiency as a collateral requirement for major studies. Students matriculating for the Bachelor of Science degree who major in chemistry must pass one year of a foreign language. Students majoring in science areas or mathematics who anticipate further studies at the graduate level are strongly advised to develop an intermediate reading proficiency in French or German.

Declaration of Major and Change of Major

Students who are admitted to the College of Pure & Applied Sciences are advised to declare their major fields during their freshman year and are required to make such declaration at the end of the sophomore year. Students should consult policies listed elsewhere in this publication under the heading "Academic Policies: Major Field Requirements" for a complete discussion of declaration of major, declaration of second major, change of major within the college of enrollment, and changes of major with intercollegiate transfer.

Transfer Policies

Students transferring to the College of Pure & Applied Sciences from other colleges of the University or from other institutions may expect recognition of previously completed courses if these are equivalent to those which are specified by curricula of the College. Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College, may not be credited to the minimum requirements for a baccalaureate degree in mathematics or the sciences. Irrespective of any previous recognition by the Office of Admissions or by other colleges of the University, a student who transfers from another college of the University to the College of Pure & Applied Sciences may not have either group of the above prerequisite courses credited to minimum degree requirements of the College.

Transfer from Other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University requirements when a student is admitted to the University and also are evaluated by major departments in terms of college and program requirements at the time a student is accepted for matriculation by the College of Pure & Applied Sciences. Courses which are transferred to the University under provisions of the Massachusetts Transfer Compact and which are not creditable to requirements of the College of Pure & Applied Sciences or as unrestricted elective courses will be listed on the student's permanent record card but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University under the Massachusetts Transfer Compact subsequently makes an intercollegiate transfer to the College of Pure & Applied Sciences, all previously completed courses, including transferred courses from other institutions, will be reevaluated in terms of their applicability to degree requirements of the College of Pure & Applied Sciences.

The applicability of grades received in transferred courses for the determination of the grade-point average of the student's major at the University of Lowell is determined by policies of each of the colleges. The policy of the College of Pure & Applied Sciences is *not* to count such grades for the purpose of determining the student's major grade-point average.

Repetition of Transferred Courses

A student who has been granted transfer credit, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form through the office of the College Dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Pure & Applied Sciences

Students wishing to transfer from another college of the University, or from baccalaureate continuing-education programs of the Evening School, must file a petition, together with a transcript of their permanent record cards, with the appropriate chairperson and the Dean of the College of Pure & Applied Sciences by November 1 for spring semester transfer and by April 1 for fall semester transfer. Students are referred to University policies concerning intercollegiate transfer which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Office of the Dean and, irrespective of grades previously received in other college programs, all courses which may not be applied to college or program requirements are deleted from the student's cumulative grade-point average.

DEPARTMENT OF BIOLOGICAL SCIENCES

Thaddeus Osmolski, Chairperson

Professors: John Bruce, Robert Coleman, Ethel Kamien, Nicholas Rencricca

Associate Professors: Jerome Hojnacki, Robert Lynch, John Mallett, Thaddeus Osmolski, Paul Protopapas, Ezequiel Rivera, Ilze Skare

Assistant Professors: David Eberiel, Curtis Hinckley, Siu-Lam Lee, John Lyon, Prentiss Shepherd, Lee-Jun Wong

The Department of Biological Sciences offers a major in the biological sciences which leads to the degree of Bachelor of Science. The Department also offers a minor area of study.

Biological Sciences Major

Curricula in the biological sciences are designed to provide appropriate sequences of science and liberal arts courses which will develop those scientific attitudes and habits of mind which are fundamental to successful careers in biology and cognate fields. Students are provided with opportunities to tailor their undergraduate education in accordance with their personal interests and career goals and the specific requirements of graduate

and professional schools. Students demonstrating high scholastic ability may conduct investigative studies throughout the senior year and complete an original research project.

Undergraduate Research Experience

Undergraduates have the opportunity to actively participate with practical "hands-on" experience in many research projects. Faculty members in the Department of Biological Sciences at the University of Lowell are actively engaged in research projects ranging from heart disease to eradication of malaria. Each member of the faculty has a distinguished scientific career as evidenced by numerous publications, attendance and participation in research conferences and acquisition of grants and contracts. Many have served as fellows in post-doctoral research programs and have conducted experiments at other institutes during their sabbatical leaves. Faculty have affiliation and research collaboration with Harvard Medical School, Harvard School of Public Health, Boston University, Sidney Farber Cancer Institute, Massachusetts General Hospital, Brigham Young University, University of Texas, Ain Shams University (Cairo), The University of Jordan (Amman), Mahidol University (Thailand), Sloane-Kettering Cancer Institute, Academy of Medical Sciences (U.S.S.R.) and the Naval Research Center, Annapolis.

Placement Record-Medical, Graduate Schools, Laboratory, Research

The percentage of students in our Pre-Health Professional Training program placed in professional schools of medicine, dentistry and optometry, is well above the national average. Graduates of our program have entered into Master's and Ph.D. programs at a number of prestigious graduate schools including Harvard, Johns Hopkins and Massachusetts Institute of Technology. Other students seeking immediate employment upon graduation have been placed in positions ranging from clinical laboratories in hospitals affiliated with Harvard Medical School to research at Wood's Hole Marine Biological Laboratories.

Advising and Pre-Health Professional Office

All students are assigned an advisor with whom the student works closely in planning his program as a biology major. The Pre-Health Professional Office includes an advisor and the Pre-Health Professional Committee for the college. It has been established for students who are primarily interested in career opportunities in such areas as medicine, dentistry, veterinary medicine and optometry. The office is geared to the student and the questions he/she may have concerning the admission process for advanced study for these professional fields.

Five-Year B.S./M.S. Program in Biological Sciences

In recognition of the need for advanced training beyond the bachelor of science level in biological sciences, the following represents a program by which outstanding undergraduates can pursue an accelerated five-year course of study leading to the B.S. and M.S. degrees in Biological Sciences.

Undergraduate students who express an interest in this program will be evaluated by our Department Graduate Selection Committee. Those students deemed commendable by the Committee will be advised relative to the correct procedure for successful completion of their B.S. degree, as well as a course of study toward the M.S. degree.

The first two years of undergraduate study will be identical to that which is specified for students enrolled in our current four-year B.S. program.

The Junior year of study will be essentially the same as that of our four-year B.S. program, except that the student will be expected to take one additional undergraduate elective course each semester. This does not constitute an overload, since 18 credits per semester will not be exceeded. This maneuver will allow for greater flexibility to pursue graduate-level training during the Senior year.

During the second semester of Junior year and upon approval and recommendation by the Department Graduate Selection Committee, the student will file formal application to the Graduate School. This does not require the student to have taken the GRE examination. The Committee decision will be based on: (a) overall grade point average, (b) grade point average in selected subjects, (c) recommendations by Department faculty, and (d) a 1-year minimum residency requirement at the University of Lowell. Upon approval and recommendation by the

Dean of the Graduate School, the student may be allowed to pursue graduate studies during the Senior year and officially become a Provisional Graduate Student in the second semester of the Senior year.

During the Senior year, the student will be permitted to take up to two graduate-level courses each semester, which can be applied towards the M.S. degree. Although advanced undergraduate (i.e. 400 level) courses are acceptable, no more than two such courses will be allowed towards the M.S. degree. It should be emphasized that the total number of credits for the combined degrees must be greater than the minimum numbers of credits required for the undergraduate B.S. degree. For example, if the University B.S. requirement is 120 credits, the student may, with approval, transfer any additional graduate-level credits toward the M.S. degree, excluding those employed for the B.S. degree.

Upon completion of the fourth year of study, assuming that all Department and University requirements have been met, the student will be awarded the B.S. degree and may then be recommended for full matriculation status by the Department Graduate Selection Committee and the Dean of the Graduate School, prior to the fifth year of study. If the student chooses not to continue toward the M.S. degree (or fails in the fifth year), this does not alter receipt of the B.S. degree.

Although the options exist for taking an overload in any semester and/or registration for one or more summer sessions, they are not of this program. However, students wishing to gain a full research experience will be encouraged to initiate their research as early as possible (e.g. during the Junior to Senior year summer session), which is a distinct advantage of this accelerated program.

During the fifth year, as in our standard M.S. degree program, the student may undertake the: (a) thesis option (9 - 12 semester hours of Graduate Research), (b) project option (3 semester hours of Graduate Project), or (c) non-research option (0 semester hours of either Graduate Research or Graduate Project). In either case, the student will be required to take a 3-credit Selected Topics in Biology: Laboratory Instrumentation course (81-651), two 2-credit Graduate Seminar courses (81-601; 81-602) and must satisfy the 33-credit minimum M.S. degree requirement. If the student has gained full matriculation status, he/she would be eligible for a Teaching Assistantship during the fifth year. Upon completion of all Departmental and Graduate School requirements, the student will be awarded the M.S. degree.

Biological Sciences Minor

A minor in biological sciences consists of the following:

1. A year sequence of a course in introductory biology with a laboratory component. This requirement may be satisfied by electing the lecture and laboratory sections in either the Principles of Biology or Life Science.
2. Four additional 3 or 4-credit courses offered by the Department of Biological Sciences with an "81" prefix. Two of these courses must have a laboratory component. At least 6 credits must be at the 300 level or above.

Summary Of Degree Requirements (Bachelor of Science)

I. University Core Requirements	23
Physical Education	2
English Composition	6
Area I (Behavioral & Social Sciences)	6-9*
Area II (Fine Arts & Humanities)	6-9*
Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified physics and mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics

II Major Field Requirements	79 - 81
A. Biological Sciences	41 - 43
81-111 Principles of Biology I	3
81-113 Principles of Biology I Laboratory	1
81-112 Principles of Biology II	3

81-114 Principles of Biology II Laboratory	3
81-201 General Microbiology	1
81-203 General Microbiology Laboratory	3
81-252 Mammalian Physiology	1
81-254 Mammalian Physiology Laboratory	3
81-335 Principles of Genetics	1
81-337 Principles of Genetics Laboratory	3
81-419 Biochemistry	2
81-421 Techniques in Biochemistry	1
81-451 Senior Seminar in Advanced Topics I	1
81-452 Senior Seminar in Advanced Topics II	1
Four electives with an "81" prefix	14 - 16
B. Supporting Sciences and Mathematics	38
84-121 Chemistry	3
84-123 Chemistry Laboratory	1
84-122 Chemistry	3
84-124 Chemistry Laboratory	1
84-221 Organic Chemistry IA	3
84-229 Organic Chemistry Laboratory IA	1
84-222 Organic Chemistry IIA	3
84-230 Organic Chemistry Laboratory IIA	1
92-131 Calculus I-B or	4
92-133 Calculus I-A	(4)
92-132 Calculus II-B or	4
92-134 Calculus II-A	(4)
92-263 Fortran Programming	3
92-385 Biostatistics	3
95-201 Principles of Physics I and	3
95-202 Principles of Physics II and	1
96-201 Principles of Experimental Physics I and	1
96-202 Principles of Experimental Physics II	1

III. Minimum Credit Requirements

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Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for degrees in the College of Pure and Applied Sciences. All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the College of Pure and Applied Sciences.

SAMPLE COURSE OF STUDY FOR BIOLOGICAL SCIENCES (BACHELOR OF SCIENCE DEGREE).#

Freshman Year

Fall Semester		Spring Semester	
*81-111 Principles of Biology I	3	*81-112 Principles of Biology II	3
*81-113 Principles of Biology I Lab	1	*81-114 Principles of Biology II Lab	1
84-121 Chemistry	3	84-122 Chemistry	3
84-123 Chemistry Laboratory	1	84-124 Chemistry Laboratory	1
+ 92-131 Calculus B-I	4	+ 92-132 Calculus B-II	4
42-101 College Writing	3	43-102 College Writing & Literature	3
39- Physical Education	1	39- Physical Education	1
	16		16

Sophomore Year

Fall Semester		Spring Semester	
81-201 General Microbiology	3	+ 81-252 Mammalian Physiology	3
81-203 General Microbiology Lab	1	+ 81-254 Mammalian Physiology Lab	1
84-221 Organic Chemistry I-A	3	84-222 Organic Chemistry II-A	3
+ 84-229 Organic Chemistry Lab	1	+ 84-230 Organic Chemistry II-A Lab	1
92-263 Fortran Programming	3	92-385 Biostatistics	3
Electives	4	Electives	3
	15		14

Junior Year

Fall Semester		Spring Semester	
81-419 Biochemistry	3	81-421 Techniques in Biochemistry	2
81-335 Principles of Genetics	3	95-202 Principles of Physics II	3
81-337 Principles of Genetics Lab	1	96-202 Principles of Experimental Physics	1
96-201 Principles of Experimental Physics I	1	Electives	9
Electives	4		15
	15		

Senior Year

Fall Semester

81-451 Sen. Sem. in Adv. Topics
Electives1
15
16

Spring Semester

81-452 Sen. Sem. in Adv. Topics
Electives1
14
15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*81-111, 113 are not prerequisite to 81-112, 114

+ Cf. Summary of Degree Requirements for listings of approved alternative courses.

Biological Sciences (Course Prefix: 81)

Courses designed primarily to satisfy the requirements of students majoring or minoring in Biological Sciences: they may also serve as electives for others with specialized interests and may be used to satisfy University Area 3 requirements.

81-111 PRINCIPLES OF BIOLOGY**I, II(3,0)3**

Introduction to biological systems above the unit organismal level. Study of plants and animals with respect to reproduction and development, behavior, genetics, evolution, ecology and biogeography. Corequisite: 81-113. Staff.

81-113 PRINCIPLES OF BIOLOGY I Laboratory**I, II(0,3)1**

A series of laboratory experiments and analyses designed to emphasize the material covered in 81-111. Staff.

81-112 PRINCIPLES OF BIOLOGY II**I, II(3,0)3**

An introduction to the structure and function of biological processes at the sub-cellular, cellular, and organismal levels. Discussions include metabolism, growth, differentiation, and physiology of plants and animals. Corequisite: 81-114. Staff.

81-114 PRINCIPLES OF BIOLOGY II Laboratory**I, II(0,3)1**

A series of laboratory experiments and analyses designed to emphasize the material covered in 81-112. Staff.

81-201 GENERAL MICROBIOLOGY**I(3,0)3**

A study of the general properties of bacteria, yeasts, molds, and viruses (anatomy, reproduction, cultivation, metabolism, genetics), a survey of major microbial infections of man (etiological agent, symptoms, antibiotics and chemotherapy), and an examination of the role of the microbes in the environment. Prerequisite: 84-126, 81-111, and 81-112. Corequisite: 81-203. Skare and Eberiel.

81-203 GENERAL MICROBIOLOGY LABORATORY**I(0,3)1**

A series of laboratory exercises covering basic qualitative and quantitative techniques in microbiology. Skare and Eberiel.

81-215 INTRODUCTION TO MARINE BIOLOGY**II(2,0)2**

An introduction to the physical and biological factors in aquatic environments with major consideration given to marine life. Emphasis is on the flora and fauna of New England. Several field trips are required. Prerequisite: 81-111, 81-112 or 83-101, 83-102. Corequisite: 81-217. Hinckley.

81-217 INTRODUCTION TO MARINE BIOLOGY LABORATORY**II(0,3)1**

A series of laboratory experiments and field trips designed to emphasize the material covered in 81-215. Hinckley.

81-220 BOTANY**II(3,0)3**

An introduction to the plant kingdom dealing with the structure, function and diversity of plants with an emphasis on seed plants. The cytology, ecology, morphology, physiology and taxonomy of plants is considered. Corequisite: 81-322.

81-221 BOTANY LABORATORY**II(0,3)1**

Greenhouse and laboratory exercises designed to emphasize material covered in 81-230.

- 81-224 INTRODUCTION TO INSECT BIOLOGY** II(2,0)2
A survey of the major groups of insects. Topics include their structures, importance, and relationship to man. Prerequisites: 81-111, 81-112 or 83-101, 83-102. Corequisite: 81-226. Lee.
- 81-226 INTRODUCTION TO INSECT BIOLOGY LABORATORY** II(0,3)1
A series of laboratory exercises designed to emphasize the material covered in 81-224. Lee.
- 81-228 ORNITHOLOGY** II(2,0)2
This course covers the various aspects of the biology of birds, including their structure, physiology, classification, field and laboratory identification, adaptations, behavior, distribution, ecology, life histories, evolution, and relationship to man, with special emphasis on the avifauna of New England. Prerequisites: 81-111, 81-112 or 83-101, 83-102. Corequisite: 81-230. Shepherd.
- 81-230 ORNITHOLOGY LABORATORY** II(0,3)1
A series of laboratory exercises designed to emphasize the material covered in 81-228. Shepherd.
- 81-252 MAMMALIAN PHYSIOLOGY** II(3,0)3
A comprehensive study into the fundamental mechanisms governing mammalian physiology. The integration of cell physiology into biologic control systems and coordinated body functions, with regard to the maintenance of homeostasis, will be considered in terms of biochemical, cytologic, anatomic and physical principles. In each instance the experimental approach into the derivation of physiologic principles will be presented and areas of further investigation will be emphasized. In all cases, the research aspects will be shown. Prerequisite: 81-111, 81-112. Corequisite: 84-222, 81-254. Rencricca.
- 81-254 MAMMALIAN PHYSIOLOGY LABORATORY** II(0,3)1
A series of laboratory exercises and experiments to demonstrate physiologic function with an emphasis on human function. Rencricca.
- 81-302 DEVELOPMENTAL BIOLOGY** II(3,0)3
Developmental phenomena are studied at the levels of macromolecules, subcellular organelles, cells, and interaction among cells. The emphasis is on current research in cellular differentiation, morphogenetic movements, nucleocytoplasmic interaction and organismal integration by nervous and hormonal mechanisms. Readings in the research literature are an integral part of the course. Prerequisites: 81-111, 81-112. Protopoulos.
- 81-304 EXPERIMENTAL MORPHOGENESIS** II(1,3)1
Lectures include discussion of experimental design and analysis, with emphasis on the critical experiments of developmental biologists. Laboratory investigations deal with problems of cellular differentiation and organogenesis, utilizing techniques of both classical experimental embryology and modern developmental biology. Corequisite: 81-302. Osmolski.
- 81-315 PRINCIPLES OF ECOLOGY** I(2,0)2
A series of lectures concerned with interrelationships of organisms with their abiotic environment with emphasis on the New England area. Selected current topics and films will supplement the text. Prerequisites: 81-111, 81-112, and 113 and 114. Corequisites: 81-317. Lyon.
- 81-317 PRINCIPLES OF ECOLOGY LABORATORY** I(0,4)2
A series of laboratory exercises to supplement and illustrate lectures of 81-315. field trips are an integral part of the course involving analysis and sampling of such components as water, soil, invertebrate fauna and characteristic flora. Directed readings, laboratory quizzes, practical exam and oral presentation of a research topic are also integral parts of the course. Corequisite: 81-315. Lyon.
- 81-324 GENERAL AND COMPARATIVE VERTEBRATE PHYSIOLOGY** II(3,0)3
A course emphasizing the comparative physiology of the vertebrates on the level of the organ-system. General physiological concepts will be covered including material on chronobiology. Among systems treated will be the circulatory, muscular, nervous, digestive and endocrine. Prerequisite: 81-111, 81-112. Corequisite: 81-326, 84-222. Hojnacki.
- 81-326 GENERAL AND COMPARATIVE VERTEBRATE PHYSIOLOGY LABORATORY** II(0,3) 1
A series of laboratory exercises which will emphasize the concepts stressed in lecture. Hojnacki.
- 81-327 HISTOLOGY** II(3,0)3
An introduction to the microscopic structure of animal tissue with emphasis upon human histology. Laboratory

investigation is an integral part of the course. Prerequisites: 81-111, 81-112, 81-113, 81-114; Corequisite: 81-329. Shepherd.

81-329 HISTOLOGY LABORATORY II(0,3) 1
A series of laboratory exercises designed to emphasize the material covered in 81-327. Corequisite: 81-327. Shepherd.

81-431 QUANTITATIVE ECOLOGY I(3,0)3
A quantitative presentation of the dynamic processes which influence the distribution and abundance of organisms in the biosphere. Consideration is directed toward field and laboratory investigations of current problems with emphasis on design and analysis of experiments. Energy flow, nutrient cycling, population growth and regulation, species diversity, community homeostasis and systems modeling techniques are examined. Prerequisite: 92-385, 81-111, 81-112. Corequisite: 81-433. Mallett.

81-433 QUANTITATIVE ECOLOGY LABORATORY I(0,3) 1
A series of field and laboratory analyses to determine quantitative relationships between organism and environment. Mallett.

81-335 PRINCIPLES OF GENETICS I(3,0)3
The theories of both classical and molecular genetics are explored with emphasis on the experimental evidence which has laid the foundation for contemporary understanding of genetics. Included is the nature of the genetic material, gene action, genetic recombination, gene regulation, gene interaction, the production and inheritance of phenotype and the behavior of chromosomes. Prerequisite: 81-111, 81-112, 84-222. Corequisite: 81-337. Osmolski.

81-337 PRINCIPLES OF GENETICS LABORATORY I(0,3)1
Laboratory investigations of the transmission and expression of morphological and physiological characters in both eukaryotic and prokaryotic organisms. Osmolski.

81-342 COMPARATIVE VERTEBRATE ANATOMY II(3,0)3
A study of the basic similarities and differences of organ systems in the vertebrates, with reference to the fields of embryology, histology, and paleontology. Representative vertebrates are studied in the laboratory. Prerequisites: 81-111, 81-112, 81-113, 81-114. Corequisite: 81-314. Shepherd.

81-344 COMPARATIVE VERTEBRATE ANATOMY LABORATORY II(0,3)1
A series of exercises designed to emphasize the material covered in 81-342. Corequisite: 81-342. Shepherd.

81-401 BIOLOGY PRACTICUM I I(0,3)1
Through observation, preparation of material and presentation of demonstrations in selected courses offered by the Department of Biological Sciences, the student becomes familiar with the materials and teaching-learning situations in biology. Staff.

81-402 BIOLOGY PRACTICUM II II(0,3)1
A continuation of 81-401. Staff.

81-411, 412 SENIOR RESEARCH IN BIOLOGY I(0,12)4; II(0,12)4
An individual, directed one year research program for senior biology majors selected on the basis of previous academic performance at the end of the junior year. Presentation of an acceptable thesis plan at the time of registration is required. A report of the research in the form of a thesis is required. Staff.

81-419 BIOCHEMISTRY I(0,3)3
A study of the structure and properties of proteins, nucleic acids, carbohydrates, and lipids which combined with a discussion of elementary enzymology allows for detailed descriptions of degradative and biosynthetic pathways, their integration and regulation. Throughout the course emphasis is on methods and practical application of fundamental information to the solution of problems of current bio-medical interest. Prerequisites: 84-222 and 84-335 recommended. Lynch.

81-421 TECHNIQUES OF BIOCHEMISTRY II(1,5)2
A series of discussions and "hands on" laboratory exercises emphasizing techniques and use of equipment most commonly employed in biochemical-biomedical research laboratories. Techniques to be mastered include: cell culture, cell fractionation, enzyme purification, ultracentrifugation, UV-visible spectrophotometry, various

types of chromatography (thin layer, gas, gel exclusion, ion exchange), electrophoresis, liquid scintillation spectrometry, the safe handling and application of radioisotopes to problems in biochemistry. Wherever possible the principles presented in 81-419 will be used as a basis for experimentation using the above techniques. Prerequisite: 81-419 or the equivalent. Lynch.

81-422 PLANT PHYSIOLOGY

II (3,0)3

A critical study of the physiological processes which occur in living plants, with emphasis on the angiosperms. Topics treated are growth and development, water relations, mineral nutrition, respiration, photosynthesis, and nitrogen metabolism. Prerequisite: 84-222 or equivalent. Corequisite: 81-424. Kamien.

81-424 PLANT PHYSIOLOGY LABORATORY

II (0,3)1

A series of laboratory experiments and analyses to illustrate the material covered in 81-422. Kamien.

81-442 CYTOLOGY

II(3,0)3

Deals with the cytoplasm incorporating the structure of cell membranes and the organelles they define; specialized organelles dealing with energy capture and transduction, some aspects of histochemical and biochemical studies on cytoplasmic organelles at the electron microscopic level. An introduction into cytogenetics and nuclear cytology; a brief discussion of prokaryotic cells. Prerequisite: 81-419 and permission of instructor. Corequisite: 81-444. Rivera.

81-444 CYTOLOGY LABORATORY

II(0,3)1

Introduction to the optical microscope as an analytical tool. Individual laboratories designed to acquaint the student with the analysis of biological ultrastructure at the optical and electron microscopic level. Corequisite: 81-442. Rivera.

81-451, 452 SENIOR SEMINAR IN ADVANCED TOPICS

I(1,0)2; II(1,0)2

Seminar discussion of selected topics of current research interest. An oral seminar presentation as well as a written report are required of all biology seniors. Staff.

81-472 VIROLOGY

II(3,0)3

A study of bacterial and animal viruses including morphology, structure, replication, biochemistry of the infected cell, viral diseases of man, and oncogenesis. Emphasis is on virus host interactions viewed at the molecular and genetic level. Prerequisites: 81-201 or 81-335. Skare.

81-474 VIROLOGY LABORATORY

II(0,3)1

A series of laboratory exercises covering basic techniques in bacterial and animal virology including virus propagation and titration, tissue culture, and biochemical and biophysical characterization of viruses. Skare.

81-484 BIOCHEMICAL GENETICS

(3,0)3

The biochemical structure and function of the eukaryotic genome will be discussed. Subject areas include the structure of chromatin, the function of histones and nonhistones and their interaction with DNA, DNA sequences, structure and function of RNA transcripts, and mechanism of DNA replication, RNA transcription, RNA processing and protein synthesis. DNA:DNA reassociation and RNA:DNA hybridization kinetics will also be discussed. Wong.

81-485 EUKARYOTIC GENE EXPRESSION

(3,0)3

A study of the regulation of gene expression in eukaryotic cells. Emphasis will be given to the regulation of gene expression at transcriptional and posttranscriptional levels during hormonal activation, cell development and cell transformation. The structure and the mechanism of expression of histones, ribosomal RNA, globin and ovalbumin genes will also be discussed. Prerequisite: 81-419, 81-335 or equivalent. Wong.

81-486 BIOCHEMICAL GENETICS LABORATORY

I(0,3)1

A series of laboratory experiments and projects designed to emphasize the material covered in 81-484. Wong.

81-491/492 SEMINAR PROJECT IN BIOLOGY

I(0,9)3; II(0,9)3

An individual, directed one semester research project taken in the fall and/or spring. Presentation of an acceptable project plan at the time of registration is required. A project report is required. Staff.

81-493 IMMUNOBIOLOGY

I(3,0)3

A study dealing with the biology of the immune response with sections of antibody production, reaction with antigen, suppression, tolerance, protection and injury. Prerequisite: 81-201, 81-419. Corequisite: 81-495 and permission of instructor. Coleman.

81-495 IMMUNOBIOLOGY LABORATORY**I(0,3)1**

A series of laboratory exercises dealing with the preparation, isolation and characterization of antigens, antibodies and effector cells. Coleman.

81-496 PRACTICUM EXPERIENCE**I, II(0,9)3**

A program of campus and/or off-campus experiences which are developed by the student in consultation with a member of the student's major department. Specific requirements will vary, depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a scientific area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of department chairperson.

81-497 & 81-498 SELECTED TOPICS IN BIOLOGY**(3,0)3**

Advanced topics in various fields of biology. Content may vary from year to year so that students may, be repeated enrollment, acquire a broad knowledge of contemporary biology. Prerequisite: Permission of instructor.

Primarily for Graduate Students

Graduate courses are open to undergraduate students with permission of the instructor.

81-501/502 SELECTED TOPICS IN BIOLOGY**(3,0)(3,0)6**

Current topics in various fields of biology presented in lecture, seminar or discussion groups. Subject matter may vary depending on interests of instructor and needs of students. May be repeated for credit when course content differs. Prerequisite: Permission of instructor.

81-503 BIOCHEMISTRY OF METABOLIC DISORDERS**(3,0)3**

This course deals with the biochemical alterations, pathophysiology, methods of detection and treatment of the following disturbances in metabolism; diabetes, obesity, alcoholism, senility, gallstone formation, fetal lung maturity, atherosclerosis, familial hyperlipoproteinemia, LCAT deficiency, Tangier disease, glycogen storage diseases. Tay-Sachs disease and Niemann-Pick disease. Current concepts in total parenteral nutrition will also be considered. Prerequisites: 81-419 and either 81-252 or 81-324. Hojnacki.

81-506 PHYSIOLOGICAL ECOLOGY**(3,0)3**

A consideration of physiological evolutionary and environmental aspects of interactions between organism and environment with special emphasis on homeostatic adaptations to biotic and abiotic environmental fluctuations. Concurrent registration in 81-508 is required for Biology majors. Prerequisites: 81-252, 81-331 or equivalent. Mallett.

81-508 PHYSIOLOGICAL ECOLOGY LABORATORY**(0,3)1**

A series of laboratory investigations designed to illustrate basic homeostatic adaptations enabling organisms to maintain internal constancy in a variable environment. Mallett.

81-510 LIMNOLOGY**(3,0)3**

An introduction to freshwater as a biogeochemical environment considering the geology, chemistry and physics of inland waters as they affect the ability of the medium to sustain life. Particular attention is addressed to basin and channel morphometry, thermal, photic, hydrologic and solvent properties of the medium. Floral and faunal components of the system are considered from populational and community aspects, evolutionary development and specific adaptations to particular niches in standing and flowing waters. Prerequisites: 81-112 and either 81-331 or 81-305. Mallett.

81-512 LIMNOLOGY LABORATORY**(0,3)1**

A series of laboratory exercises designed to emphasize the material covered in 81-510. Mallett.

81-518 EXPERIMENTAL HEMATOLOGY**(3,0)3**

An introduction to the physiology of the erythropoietic system. Emphasis will be given to the proliferation and differentiation of hemopoietic stem cells with regard to the regulation and maintenance of homeostasis. Abnormalities and perturbations resulting in diseased conditions, such as anemia and polycythemia, will be discussed. Prerequisite: 81-252 or equivalent. Rencricca.

- 81-520 EXPERIMENTAL HEMATOLOGY LABORATORY** (0,6)2
A series of laboratory exercises and projects designed to employ basic and advanced techniques in hematology and which emphasize the material covered in 81-522. Rencricca.
- 81-529 BIOCHEMICAL ASPECTS OF HEART DISEASE** (3,0)3
This course emphasizes a comparison of normal and abnormal functions of the heart and blood vessels. Topics include a discussion of the relationship between nutrition, circulating fat and heart disease, aorta cell metabolism, metabolism of fat in the human body, risk factors in coronary heart disease, and current biochemical methods employed in cardiovascular research. Prerequisite: 81-419 and either 81-252 or 81-324. Hojnacki.
- 81-531 REGULATION IN ANIMAL METABOLISM** (3,0)3
Lectures and discussion related to factors determining direction and rate of flux of substrates through a variety of interrelated metabolic pathways. Both hormonal and non-hormonal mechanisms involved in generating an integrated metabolic response to changes in nutrient availability will be examined. Emphasis will be on studies in mammalian systems. Prerequisite: 81-419 or equivalent. Lynch.
- 81-541 TOPICS IN CELL BIOLOGY** (3,0)3
The fundamental structure and function of the cell will be discussed in detail. Some of the topics to be discussed are: 1. the anatomy and biochemistry of cellular membranes. 2. Transport mechanisms. 3. Systems developed by various life forms for motility. 4. Properties of excitable cells. 5. Energy transduction mechanisms. Wherever possible, comparisons between the biology of normal and transformed cells will be made. May be repeated for credit when course content varies. Prerequisite: 81-419. Rivera.
- 81-542 CYTOLOGY*** (3,0)3
The structure of eukaryotic cells. Study of cell membranes and organelles they define; specialized organelles for energy capture and transduction; aspects of histochemical and biochemical studies of organelles at the optical and electron microscopic level. An introduction into cytogenetics and nuclear cytology; a brief discussion of prokaryotic cells. A substantial library investigation of some aspects of cell structure and/or function is required. Prerequisite: 81-419 or equivalent. Co-requisite: 81-544. Rivera.
- 81-544 CYTOLOGY LABORATORY*** (0,3)1
Introduction to the optical microscope as an analytical tool. Individual laboratories designed to acquaint the student with the analysis of biological ultrastructure at the optical and electronmicroscopic level. Cell fractionation. Chromosome preparations. One substantial ultrastructural analysis required. Corequisite: 81-542. Rivera.
- 81-552 RECOMBINANT DNA TECHNIQUES** (3,0)3
A study of the principles and specialized techniques of purifying, manipulating and cloning of recombinant DNA molecules. Includes techniques involving restriction enzyme mapping of genomes, cloning of DNA from prokaryotes and eukaryotes, types of plasmid and viral vectors used in genetic engineering, and the applicability of these techniques to solution of various problems in cell biology. Prerequisites: 81-419, 81-335 or 81-472. Skare.
- 81-561 ELECTRON MICROSCOPY - THEORY** (3,0)3
An introduction to the theory of electron microscopes and electron optics. Preparation of biological specimens for electron microscopic viewing and photography. Analysis of data obtained with electron microscopic techniques. Applications in biology will be discussed. Prerequisite: 81-419, 81-308, and permission of instructor. Rivera.
- 81-562 ELECTRON MICROSCOPY - LABORATORY** (0,9)3
Operation of Scanning and Transmission Electron Microscopes. Project required of all students. Use of ancillary optical equipment. Prerequisite: 81-561, permission of instructor. Rivera.
- 81-564 EXPERIMENTAL HEMATOLOGY: A STUDY OF CURRENT LITERATURE** (3,0)3
This course will involve group discussions of the recent scientific literature in experimental hematology. Cellular and humoral mediators of blood cell production will be assessed relative to hemopoietic stem cell proliferation, differentiation and migration, with an emphasis on erythropoiesis. Papers dealing with abnormalities and perturbations resulting in diseased states will be included for discussion. Prerequisite: 81-518 or equivalent. Rencricca.
- 81-565 ROLE OF MICRONUTRIENTS IN MAMMALIAN NUTRITION** (3,0)3
The biochemical mode of action of selected vitamins and minerals as well as mechanisms involved in regulating their absorption, conservation, and metabolism will be emphasized. Where possible their significance in the context of human nutrition and disease will be discussed. Prerequisites: 81-252, 81-419 or equivalent. Lynch.

81-572 VIROLOGY**(3,0)3**

A study of bacterial and animal viruses including viral structure, modes of replication, biochemistry or the infected cell, genetic properties, and viral oncogenesis. Emphasis is on virus-cell interactions at the molecular level. A library investigation of a current topic is required. Prerequisites: 81-419, 81-201 or 81-335. Skare.

81-574 VIROLOGY LABORATORY**(0,3)1**

A series of laboratory experiments covering current techniques in bacterial and animal virology. Included are virus propagation and titration, biochemical, biophysical, and genetic analysis of viral nucleic acids and proteins, and cell culture techniques. Skare.

81-584 BIOCHEMICAL GENETICS**(3,0)3**

The biochemical structure and function of the eukaryotic genome will be discussed. Subject areas include the structure of chromatin, the function of histones and nonhistones and their interaction with DNA, DNA sequences, structure and function of RNA transcripts, and mechanism of DNA replication, RNA transcription, RNA processing and protein synthesis. DNA•DNA reassociation and RNA•RNA hybridization kinetics will also be discussed. A library investigation of a current topic is required. Prerequisites: 81-419, 81-335 or equivalent. Wong.

81-585 EUKARYOTIC GENE EXPRESSION**(3,0)3**

A study of the regulation of gene expression in eukaryotic cells. Emphasis will be given to the regulation of gene expression at transcriptional and posttranscriptional levels during hormonal activation, cell development and cell transformation. The structure and the mechanism of expression of histones, ribosomal RNA, globin and ovalbumin genes will also be discussed. A library investigation of a current topic is required. Prerequisites: 81-419, 81-335 or equivalent. Wong.

81-586 BIOCHEMICAL GENETICS LABORATORY**(0,3)1**

A series of laboratory experiments and projects designed to emphasize the material covered in 81-584. Wong.

81-587 CELLULAR IMMUNOLOGY**(3,0)3**

Categories, cells, mediators, signals, interactions and regulation of immunological reactions involving cell-mediated immunity. Prerequisites: 81-493, 81-495 or equivalent. Coleman.

81-589 CELLULAR IMMUNOLOGY LABORATORY**(0,3)1**

A project laboratory designed to illustrate aspects of material covered in 81-587. Coleman.

Applied Biology (Course Prefix: 82)

Courses of an interdisciplinary nature exploring areas resulting from the interaction of Biological Science with other fields - academic, professional, or practical. Because of their hybrid nature, these courses may not be used to satisfy University Area 3 requirements.

82-161 EMERGENCY CARE - A FIRST RESPONDERS COURSE**I(2,2)3**

The objective is to provide training in all aspects of immediate emergency medical care required at the scene of an accident or illness. The scope of the course concerns itself with the roles and responsibilities a first responder has at the accident scene. These include medical-legal aspects of rendering emergency care, treating life threatening emergencies including airway care, CPR, control of bleeding and shock; treating accident-related injuries including wounds, fractures and burns. Also discussed will be illnesses or conditions such as heart attack, stroke, diabetes, epilepsy, abuse of alcohol and drugs, and childbirth. The student will learn patient examination, diagnosis, and triage; how to gain access to patients using simple handtools; and how to move injured persons. The emphasis of the training is devoted to the practical aspects of emergency care rendered at the scene. Under Mass. Gen. Law chapter III section 201, all police officers, firefighters and lifeguards not assigned to administrative duties are required to be trained to the first responder level minimally. This course fills both the need of present and future law enforcement officials. Eberiel.

82-202 HEREDITY AND SOCIETY**II(3,0)3**

Lectures and readings dealing with the genetic aspects of social problems emphasize that the borderline between genetics and medicine, ethics, politics, sociology, psychology, and agriculture are fertile areas for the development of new concepts. Successful completion of the course enables the student to offer informed opinions each time the genetic basis of social predicaments is introduced into the arena of public affairs and to correct many misconceptions in the public mind. Osmolski.

- 82-261 EMERGENCY MEDICAL CARE I** I(2,2)3
This course provides the necessary knowledge and skill to give emergency medical care at the emergency scene. The curriculum covers the basics of understanding the emergency situation, as well as specialized emphasis in respiration and resuscitation, bleeding, wounds and shock, use and care of emergency equipment commonly accepted and employed such as suction machines, oxygen delivery systems, backboards, fracture kits, obstetrical kits, stretchers of various types and light rescue tools. Also taught are management of mentally disturbed patients, and initial care of poison and burn patients along with environmental emergencies. Included in the course are lectures on anatomy and physiology by local physicians. Successful completion of the course prepares the student to take the National Registry Examination for Emergency Medical Technician. Must be followed by 82-262. Eberiel.
- 82-262 EMERGENCY MEDICAL CARE II** II(2,2)3
A continuation of 82-261. Prerequisite: 82-261. Eberiel.
- 82-351 HUMAN SEXUALITY** I, II(3,0)3
Lectures and discussions concerning the biological aspects of human sexuality. Topics include the anatomy and physiology of the reproduction system, sexual development, maleness and femaleness, contraception, abortion, errors, and problems. Three lecture-discussions per week. Kamien and Hinckley.
- 82-354 WILDLIFE AND ENVIRONMENTAL MANAGEMENT** II(3,0)3
An introduction to some of the concepts and principles applicable to forest and wildlife utilization. Esthetic and economic considerations will be discussed and serve as the basis for oral and written presentations. Practical experiences in the laboratory and the field such as census methods, tree classification and skinning methods will supplement lecture material. Prerequisite: 81-315, 317, or a field-oriented ecology course or permission of instructor. Lyon.
- 82-419 PRINCIPLES OF EVOLUTION** I(0,3)3
Drawing knowledge from many different fields of biology this course discusses the evidence, process, and mechanisms of evolution. Topics will include the origin of life and of man, the organization of genetic variability, changes and differentiation in population, mechanisms of speciation, adaptation and natural selection. Prerequisite: 81-335. Lee.
- 82-551 HUMAN SEXUALITY: CURRENT PERSPECTIVES**
The biological, psychosocial, and attitudinal aspects of human sexuality are dealt with from a variety of perspectives. This course is designed to serve the needs of biologists, teachers, counselors, health professionals, and others concerned with the applied aspects of the subject. Kamien.

Life Sciences (Course Prefix: 83)

Courses designed primarily to service the needs of students who are not majoring or minoring in Biological Science. Although these courses may not ordinarily be used for degree credit for students majoring in Biological Sciences, they may be used as electives for others and may be used to satisfy University Area 3 requirements.

- 83-101 Life Science I** I, II(3,0)3
An introduction to the study of biology which considers the earth's environment as a community in which plants and animals live, interact, and demonstrate the genetic variations which enable them to adapt to changes and to evolve. Man's roles as producer, consumer, polluter and conserver will receive attention.
- 83-103 LIFE SCIENCE LABORATORY I** I, II(0,2)1
Laboratory work associated with 83-101. Corequisite: 83-101. Staff.
- 83-102 LIFE SCIENCE II** I, II(3,0)3
The emphasis in this course will be on cellular and organismal structure, function, reproduction and behavior. Staff.
- 83-104 LIFE SCIENCE LABORATORY II** I, II(0,2)1
Laboratory work associated with 83-102. Corequisite: 83-102. Staff.
- 83-122 THE PLANT AND YOU** I(3,0)3
A humanistic approach to botany emphasizing the interrelationships between plants, people, and human civilization.

tion. Plant structure and function, and aspects of genetics, evolution and ecology will be included. In the laboratory and greenhouse, students will explore the interrelationships between function, structure and environment in plants. Kamien.

83-123 NUTRITION AND DISEASE

I(3,0)3

Topics include a discussion of the nutritional aspects, symptoms, methods of detection, genetics, and treatment of the following disorders: diabetes, obesity, alcoholism, senility, gallstone formation, fetal lung maturity, heart disease, and familial high blood cholesterol. Hojnacki.

83-126 HUMAN DISEASE AND IMMUNITY

II(3,0)3

An introductory course for students for majoring in Biology, dealing with the immune response of the human body to selected viral, bacterial, parasitic, cancerous, allergic and autoimmune factors of disease. The influence of aging, alcohol, drugs, nutrition, and smoking on the response will be discussed. Coleman.

83-214 HUMAN ECOLOGY

II(3,0)3

A course designed to reveal and discuss the increasing problems of over-population in regard to environmental deterioration, living space, limits of natural resources and the adverse effects of man's alteration or destruction of the natural ecosystem. The implications of current literature and news items will be emphasized. Individual oral and written presentations are an integral part of the course. Prerequisite: a year of college biology or equivalent. Lyon.

DEPARTMENT OF CHEMISTRY

Stuart Clough, Chairperson

Professors: William Bannister, Eugene Barry, Alexandre Blumstein, Rita Blumstein, Stuart Clough, Stanley Israel, Ernest James, Joseph Killelea, Philip Lamprey, Robert Peirent, James Pierce, Chong Pyun, Harry Rubinstein, Joseph Salamone, Ruth Tanner, Arther Watterson.

Associate Professors: Martin Isaks, Robert Litman, Albert Kowalak, Irving Lipschitz, Shan Wong.

Assistant Professors: Don Hilton, Judith Kelley, Kuang-Pang, Samuel Sawan, Barbara Smith.

Professor Emeritus: Allen Scattergood.

The Department of Chemistry strives to make its programs current by a continuous re-evaluation by its faculty members and its consumers. An outside advisory board of industrial and academic chemists has been established to meet periodically with and advise the department on all aspects of its academic program. Current members of the advisory board are as follows:

Ernest I. Becker
Department of Chemistry
University of Massachusetts at Boston

Charles Chiklis
Polaroid Corporation
Cambridge, Massachusetts

Rosemary Ellersick
Abcor, Incorporated
Wilmington, Massachusetts

Paul F. Fennelly
GCA Corporation
Bedford, Massachusetts

William E. Gibbs
Foster Grant Co., Incorporated
Leominster, Massachusetts

Nathaniel S. Schneider
Army Materials & Mechanics Research Center
Watertown, Massachusetts

M. Frederick Hoover
Ventron Corporation
Beverly, Massachusetts

Philip W. LeQuessne
Department of Chemistry
Northeastern University

Roger S. Porter
Department of Polymer Science & Engineering
University of Massachusetts at Amherst

Peter N. Rigopoulos
Amicon Corporation
Lexington, Massachusetts

Carlos M. Samour
Samour Associates
Needham Heights, Massachusetts

Chemistry Major

Chemistry is both a basic and an applied science and, as such, is fundamental not only to an understanding of the structure, properties, and reactions of matter, but also to comprehension of the very nature of twentieth-century civilization. Career opportunities in chemistry are as many and as varied as are the applications of chemistry to contemporary life and include, by way of example, applied and basic research, product analysis, manufacturing,

and marketing. Completion of the chemistry curricula also provides preparation for all areas of the chemical profession as well as for graduate study in chemistry, dentistry, medicine, and teaching.

Both the Bachelor of Arts and the Bachelor of Science degree programs have been approved by the Committee on Professional Training of the American Chemical Society, and program options and course offerings are designed to meet the latest recommended standards. However, program options permit students to graduate as chemistry majors without meeting all of the requirements of the American Chemical Society. In such cases, a degree is not approved by the Society. Major programs of the Bachelor of Arts and Bachelor of Science degrees include required courses which supply a thorough grounding in basic chemistry principles and techniques and provide flexible requirement options in areas of analytical chemistry, biochemistry, environmental chemistry, inorganic chemistry, organic chemistry, physical chemistry, radiochemistry, and polymer chemistry. Chemistry programs also permit the incorporation of specialized laboratory or research courses which provide up-to-date knowledge concerning the utilization of such sophisticated instrumentation as atomic absorption spectroscopy, electron microscopy, gas liquid chromatography, nuclear magnetic resonance spectroscopy, and x-ray spectroscopy. In addition to supporting courses in physics and mathematics, the two chemistry curricula also include courses in the humanities and social sciences and permit limited elective programs in such fields as chemical engineering, materials science, chemical energy, business administration, technical writing and illustrating, and environmental science.

The Bachelor of Arts curriculum offers the student who is interested in such fields as chemical journalism or literature, illustrative arts (e.g., chemical graphics and illustrations), languages (technical translating), social sciences and the humanities with the opportunity to elect a major in chemistry while also pursuing options in areas of the humanities and social sciences. The Bachelor of Arts Curriculum is also an appropriate program for students who are interested in preparing for teaching at the secondary school level and wish to pursue a graduate program in education. Although the curriculum of the Bachelor of Science degree is generally elected by students who are interested in professional careers in chemistry fields, the curriculum of the Bachelor of Arts degree is an equally appropriate choice for such students, especially when it is completed in accordance with requirements of the American Chemical Society.

The Bachelor of Science curriculum is directed to students who are interested in becoming professional chemists. Although the curriculum specifies a basic core of courses which are directed to basic principles and techniques, it is a flexible program of requirements which allows each student to select advanced courses according to his or her interests and goals and to pursue studies which combine proficiency in chemistry with training in such fields as business administration, biological sciences, mathematics, chemical engineering, electrochemistry, radiochemistry, materials science, chemical energy, and polymer chemistry. Courses in physics, mathematics, languages, social science, and literature serve to support the chemistry courses and to prepare the student to interact effectively in both social and professional settings.

American Chemical Society certification requires a total of 400 hours, or the equivalent, of traditional classroom work, and a total laboratory experience of not less than 500 hours*. An allowance of 75 hours may be given for laboratory work associated with independent study and research. In addition to the chemistry core noted below, three semesters of advanced work are needed for certification. Independent study or research may be counted as one of the three semesters. The courses should be at a level that utilizes fully the concepts and techniques developed in the core curriculum and should have prerequisites of academic year courses in organic chemistry and physical chemistry. In view of the current importance of inorganic chemistry, biochemistry, and polymer chemistry advanced courses in these areas are especially recommended and students are strongly encouraged to take one or more of them.

Besides advanced courses in chemistry students may, with the approval of the chemistry Department undergraduate policy committee take advanced courses in interdisciplinary fields such as chemical physics, solid state physics and environmental chemistry; or in areas closely allied with chemical sciences such as mathematics, physics, computer science, statistics, molecular biology, geochemistry, and chemical engineering.

*The required chemistry core of 38 credits provides 406 hours of classroom work and 434 hours of laboratory.

Cooperative Education Program

The Department of chemistry has formally adopted the voluntary University Cooperative Education Work Experience Program. This Program is designed to combine chemistry-oriented work experience in industrial or

related laboratories with opportunities to earn an income. The Department schedules the student to start the off-campus program after the completion of four semesters of academic work, which must include the successful completion of one year of organic chemistry and one semester of physical chemistry. Co-Op I begins in the summer session of the second year. Co-Op II begins in the spring semester of the third year. Co-Op III begins in the fall semester of the fifth year. Any University credit granted for the Cooperative Education Program will not be applicable to minimum credit requirements for the graduation as a chemistry major. For further information concerning the Cooperative Education Program, consult University policies which appear elsewhere in this publication under the heading of "Academic Policies: Cooperative Education".

Financial Support for Chemistry Majors

In addition to the usual financial resources for undergraduate, the department has special scholarships totaling about \$4,000 available to its students along with awards for outstanding achievement. The major scholarships and awards are:

Roland E. Derby Memorial Scholarship
Eastman Kodak Undergraduate Scholarship
Russell Weeks Hooke Scholarship
Atlantic Richfield Co. Fellowship
Allen Scattergood Scholarship

American Institute of Chemists Annual Award
Louis A. Olney Book Prizes
Chemistry Department Award
Chemistry Textbook Awards

The department has also employed several of its majors as graders and laboratory aides. Funded research projects have, on occasion, employed exceptional undergraduates.

Chemistry Awards

Chemistry Award: An award is given to the freshman student in chemistry who shows the greatest achievement in chemistry.

Louis A. Olney Book Prizes: Stipends of \$80, \$100, and \$150 are awarded each spring respectively to a sophomore, junior and senior chemistry major. Awards are based solely on scholastic achievement.

American Chemical Society Affiliate Chapter Award: An award is presented annually by the ACS Student Affiliate Chapter to the outstanding senior majoring in chemistry or chemical engineering based upon academic performance and demonstration of research capability.

Chemistry Scholarship & Loan Programs

Roland E. Derby, Sr. Memorial Scholarship: This Scholarship is awarded in alternate years to a sophomore who is a chemistry or chemical engineering major and is granted on the basis of scholarship and financial need. The stipend is \$500 per year and is renewable for recipients in good academic standing.

Russell Weeks Hook Scholarship: This scholarship is awarded each year to two chemistry majors in the sophomore, junior and senior classes and is granted on the basis of scholarship and financial need. The stipend is \$400 per year and is renewable for recipients in good academic standing.

Geigy Dystuff Student Loan Fund: Students in chemistry and paper engineering may borrow from this fund at an interest rate of 1% per quarter. The loan becomes due following graduation.

Chemistry Minor

A minor of chemistry consists of 18-24 credits in chemistry, exclusive of any course work taken to satisfy the area III requirement. All course prerequisites must be satisfied. The course requirements for the chemistry minor are as follows:

- A freshman level course (84-121, 123, and 84-122, 124) or the equivalent must be included.
- Beyond the required freshman level course, four additional courses are required, of which not more than two may be from the same chemistry area.
- At least two courses must carry a laboratory component exclusive of 84-121, 123 and 84-122, 124 or its equivalent.

- d. A lecture course with a corequisite laboratory course will be considered as one course for the additional course requirement.
- e. At least eight semester hours must be taken at or above the 300 course level, and of these courses, at least 3 credits must be in a chemistry course or courses not required by the curriculum of the student's department.

Summary of Degree Requirements (Bachelor of Arts)

I. University Core Requirements	23
Physical Education	2
Area I (Behavioral & Social Sciences)	6-9 *
Area II (Fine Arts & Humanities)	6-9 *
Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified physics and mathematics courses of the major field requirements for supporting sciences & mathematics.

II. Major Field Requirements	38	63-66
A. Chemistry		
84-121 Chemistry		3
84-123 Chemistry laboratory		1
84-122 Chemistry		3
84-124 Chemistry laboratory		1
	or	
84-135 Honors Chemistry		3
84-137 Honors Chemistry laboratory		1
84-136 Honors Chemistry		3
84-138 Honors Chemistry laboratory		1
84-207 Inorganic Chemistry		3
84-209 Inorganic Chemistry laboratory		2
84-221 Organic Chemistry IA		3
84-227 Organic Chemistry laboratory I		1
84-222 Organic Chemistry IIA		3
84-228 Organic Chemistry laboratory II		1
84-313 Analytical Chemistry I		3
84-315 Analytical Chemistry I laboratory		1
84-314 Analytical Chemistry II		3
84-316 Analytical Chemistry II Laboratory		1
84-344 Physical Chemistry I		3
84-346 Physical Chemistry I laboratory		1
84-345 Physical Chemistry II		3
84-350 Physical Bioinorganic Chemistry laboratory		2

*ACS Accreditation requires additional courses beyond the chemistry core. CF. ACS requirements above. Not more than 45 credits in chemistry may be credited to the minimum BA requirements of 122 credits.

B. Supporting Sciences and Mathematics	25-28
95-201 Principles of Physics I	3
96-201 Principles of Experimental Physics I	1
95-202 Principles of Physics II	3
96-202 principles of Experimental Physics II	1
92-131 Calculus I-B and	4
92-132 Calculus II-B and	4
92-231 Calculus III-B or	4
92-133 Calculus I-A	(4)
92-134 Calculus II-A	(4)
92-233 Calculus III-A	(3)

Two additional science courses exclusive of mathematics and chemistry 6-8

III Program Options#

A minimum of 29 credits (in addition to Area I and Area II) must be taken from course offerings of the College of Liberal Arts, the College of Music, and the economics offerings of the College of Management Science. These courses are selected by students in accordance with their needs, interests, and talents, and in consultation with faculty advisors. Minor areas of study* may be selected in the College of Liberal Arts. A minor in economics* also may be selected in the College of Management Science.

*Minors require 18-24 credits and six courses with a minimum of 6 credits at the 300 course level or above. Requirements are established by concerned departments.

#Courses which are prerequisites for physics, chemistry, and mathematics courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for a baccalaureate degree in chemistry.

Summary of Degree Requirements (Bachelor of Science)

I. University Core Requirements	23
Physical Education	2
English Composition	6
Area I (Behavioral & Social Sciences)	6-9*
Area II (Fine Arts & Humanities)	6-9*#
Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified physics and mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics.

#Six credits of a foreign language are required. These credits may be used to fulfill the Area II Requirement.

II. Major Field Requirements 66-73

A. Chemistry*

84-121 Chemistry	3
84-123 Chemistry laboratory	1
84-122 Chemistry	3
84-124 Chemistry laboratory	1

or

84-135 Honors Chemistry	3
84-137 Honors Chemistry laboratory	1
84-136 Honors Chemistry	3
84-138 Honors Chemistry laboratory	1
84-207 Inorganic Chemistry	3
84-209 Inorganic Chemistry laboratory	2
84-221 Organic Chemistry IA	3
84-227 Organic Chemistry laboratory I	1
84-222 Organic Chemistry IIA	3
84-228 Organic Chemistry laboratory II	1
84-313 Analytical Chemistry I	3
84-315 Analytical Chemistry I laboratory	1
84-314 Analytical Chemistry II	3
84-316 Analytical Chemistry II Laboratory	1
84-344 Physical Chemistry I	3
84-346 Physical Chemistry I Laboratory	1
84-345 Physical Chemistry II	3
84-350 Physical Bioinorganic Chemistry laboratory	2

*The minimum chemistry or chemistry-related requirement for ACS certification is 47 credits. CF. ACS program requirements under the general statement concerning the chemistry major.

B. Physics

95-141 Physics I or	12-17
95-147 Honors Physics I	3
96-147 Fundamentals of Experimental Physics I (Honors)	(4)
95-144 Physics II or	1
95-148 Honors Physics II	3
96-148 Fundamentals of Experimental Physics II (Honors)	(4)
95-245 Physics III or	1
95-247 Honors Physics III	3
96-245 Fundamentals of Experimental Physics III or	(4)
96-293 Experimental Physics I	1
	(3)

C. Mathematics

92-131 Calculus I-B	16-18
92-132 Calculus II-B	4
92-231 Calculus III-B	4
92-232 Calculus IV-B or	4
92-131 Calculus I-B	4
92-132 Calculus II-B	(4)
	(4)

92-231 Calculus III-B	(4)
*92-383 Introduction to Statistics or	(3)
92-133 Calculus I-A	(4)
92-134 Calculus II-A	(4)
92-233 Calculus III-A	(3)
92-234 Differential Equations or	(3)
92-133 Calculus I-A	(4)
92-134 Calculus II-A	(4)
92-233 Calculus III-A	(3)
*92-383 Introduction to Statistics	(3)
92-361 Digital Computer Programming	2

*92-383 is strongly recommended.

III Allied Courses#

18-24

The required chemistry minimums permit students to elect limited prorams outside the Department of Chemistry for the purpose of developing specific interests. In consultation with their advisors, students may choose a minor of 18-24 credits or may wish to consider the following groups of electives a preparation for various fields allied with chemistry. A minimum of 6 credits at the 300-400 course levels is required for all minors.

Business Administration Electives		Chemical Energy Electives	
66-200 The Business System	3	10-431 Coal Technology	3
50-201 Accounting Principles I	3	10-434 Petrochemicals	3
60-202 Accounting Principles II	3	16-471 Energy Conversion	3
64-201 Economics I	3	80-201 Physics of Radiation	3
64-202 Economics II	3	80-202 Physics of Nuclei	3
64-211 Statistics I	3	84-351 Chemistry of Fossil Fuels Coal and Oil Shale	3
		84-352 Chemistry of Fossil Fuels Petroleum and Natural Gas	3

*Students may not receive credit for both 92-383 and 64-211, 212.

Chemical Engineering Electives		Electrochemistry Electives	
10-203 Introduction to Chemical Engineering	3	16-201 Introductory Circuit Theory I	4
10-204 Chemical Engineering Calculations	3	16-207 Electrical Engineering Laboratory	2
10-206 Fluid Mechanics	3	16-202 Introductory Curcuit Theory II	4
10-305 Heat Transfer	3	16-208 Electrical Engineering Laboratory	2
10-306 Transport Phenomena	3		
10-409 Economic and Process Analysis	3		
10-310 Separation Processes	3		

The chemical engineering sequence prepares the student to enter a master's program in chemical engineering with minimum deficiencies in instrumentation, controls, and reaction kinetics.

Materials Science Electives		Polymer Science Electives	
10-308 Engineering Materials	3	84-403 Introductory Polymer Science I	3
22-395 Materials Science	3	84-404 Introductory Polymer Science II	3
26-201 Polymeric Materials I	3	84-405 Polymer Laboratory I	1
26-202 Polymeric Materials II	3	84-406 Polymer Laboratory II	1

IV Unrestricted Elected courses

3-15

#Prerequisites for physics, chemistry, and mathematics courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for a baccalaureate degree in chemistry. All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the College of Pure and Applied Sciences.

V Minimum Credit Requirement

SAMPLE COURSE OF STUDY FOR CHEMISTRY (Bachelor of Arts Degree)##

Freshman Year			
Fall Semester		Spring Semester	
* 84-121 Chemistry	3	* 84-122 Chemistry	3
* 84-123 Chemistry Laboratory	1	* 84-124 Chemistry laboratory	1
95-201 Principles of Experimental Physics	1	96-202 Principles of Experimental Physics	1
* 92-131 Calculus B-I	4	* 92-132 Calculus B-II	4
42-101 College Writing	3	42-102 College Writing and Literature	3
39 Physical Education	1	39 Physical Education	1
	16		16
Sophomore Year			
Fall Semester		Spring Semester	
84-221 Organic Chemistry I-A	3	84-222 Organic Chemistry II-A	3
84-227 Organic Chemistry Laboratory	1	84-228 Organic Chemistry Laboratory	1
* 92-231 Calculus B-III	4	84-344 Physical Chemistry I	3
84-207 Inorganic Chemistry	3	84-346 Physical Chemistry Laboratory I	1
84-209 Inorganic Chemistry Laboratory	2	Electives +	6-9
Elective +	3		
	16		14-17

Junior Year

Fall Semester

84-313 Analytical Chemistry I	3
84-315 Analytical Chemistry Laboratory	1
84-345 Physical Chemistry II	3
84-350 Physical Bioinorganic Chemistry Laboratory	2
Electives + #	6-9
	15-18

Spring Semester

84-314 Analytical Chemistry II	3
84-316 Analytical Chemistry Laboratory	1
Electives + #	12-14
	16-18

Senior Year

Fall Semester

Electives + #	14-16
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Spring Semester

Electives	14-16
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##Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Cf summary of Degree Requirements for listings of approved alternate courses.

+ University Core Requirements, supporting sciences and mathematics, liberal arts, music, or economics courses, or general electives.

#For American Chemical Society approved programs of study it is recommended that students take at least one of the following electives:

84-334, 84-419, 84-403, 84-404, 97-503, or 97-504

The following are recommended chemistry electives with laboratory hours:

84-321 (1-6)3	84-342 (1-6)3	84-405 (0-4)1
84-407 (0-9)3	84-408 (0-9)3	84-421 (0-4)1
84-586 (0-4)1	84-516 (1-6)3	84-406 (0-4)1

Cf. ACS program requirements under the general statement concerning the chemistry major.

Chemistry (Course Prefix: 84)

84-101 INTRODUCTORY CHEMISTRY

I(3,0)3

An Introduction to atomic structure, chemical bonding, physical and chemical changes, organic chemistry, with emphasis on the application of the theory to topics such as nuclear chemistry, air and water pollution, food additives, drugs and pesticides, and a variety of energy sources.

84-111 GENERAL CHEMISTRY I

I(3,0)3

A one-semester survey of the principles of inorganic chemistry: The structure of matter, the quantitative aspects of chemical reactions, solution chemistry, including acid-base chemistry and ionic equilibria. Corequisite: 84-113. Note: This is not an appropriate course for students in the College of Pure and Applied Science (See 84-121 and 84-122).

84-113 GENERAL CHEMISTRY LABORATORY I

I(0,3)1

The laboratory course corequisite with 84-111, with experiments designed to cover the structure of matter, the quantitative aspects of chemical reactions, and solution chemistry, including acid-base chemistry and ionic equilibria.

84-112 GENERAL CHEMISTRY II

II(3,0)3

A survey of the basic principles of organic chemistry and biochemistry with emphasis on biochemical aspects of carbohydrates, lipids, proteins and nucleic acids. Various metabolic pathways are also emphasized. Primarily for nursing majors. Prerequisite: 84-111; corequisite: 84-114

84-114 GENERAL CHEMISTRY LABORATORY II

II(0,3)1

Laboratory experiments designed to illustrate the principals discussed in 84-112. Prerequisite: 84-113 or permission of instructor. Corequisite: 84-112

84-121 CHEMISTRY I

I(3,0)3

An introduction to the basic concepts of chemistry. Topics include chemical calculations, atomic structures, the periodic table, basic bonding theory, solutions, liquids, gases. Corequisite: 84-123.

84-122 CHEMISTRY II

II(3,0)3

A continuation of 84-121. Topics include thermodynamics, kinetics, acids and bases, introduction to organic chemistry, chemical equilibrium, precipitation reactions, electrochemistry. Prerequisite: 84-121; corequisite: 84-124.

84-123 CHEMISTRY LABORATORY

I(0,3)1

An experimental study of chemical principles and chemical transformation that is coordinated with topics considered in 84-121. Some of the more important reactions of elements, oxides, acids, bases and salts are examined.

Other topics include chemical separation, purification, preparation of inorganic salts: Quantitative determinations dealing with the formula of a compound, gas laws, and colligative properties are performed. Careful technique and precise measurements are stressed. Corequisite: 84-121.

84-124 CHEMISTRY LABORATORY II(0,3)1

A continuation of the laboratory study begun in 84-123 that is coordinated with topics of 84-122. Topics include: thermochemistry, kinetics, spectroscopy, titration, pH, equilibrium reactions and constants. Some aqueous solution reactions and organic reactions are examined. Accurate measurements and precise instrumental and apparatus operation are expected. Prerequisite: 84-123; corequisite: 84-122.

84-135 HONORS CHEMISTRY *(3,0)3

A course designed for capable students. Periodic relationships and principles of stoichiometry, chemical structure, and states of matter are used to characterize the nature of chemical substances. The chemical reactions of certain inorganic substances are considered. Students are encouraged to contribute ideas, question concepts, and participate in discussions. Prerequisite: invitation or permission of instructor; corequisite: 84-137.

84-136 HONORS CHEMISTRY II(3,0)3

A continuation of 84-135. States of matter, thermodynamics, solution phenomena, chemical kinetics, chemical equilibrium, electrochemistry, and acid-base phenomena are used to characterize the chemical reactions of both organic and inorganic substances. Students are encouraged to participate in the discussion of course material. Prerequisite: 84-135 or permission of instructor; corequisite: 84-138.

84-137 HONORS CHEMISTRY LABORATORY I(0,3)1

A series of laboratory experiments designed to illustrate the principles discussed in 84-135 and to train the student in the techniques of experimentation. Prerequisite: invitation or permission of instructor. Corequisite: 84-135.

84-138 HONORS CHEMISTRY LABORATORY II(0,3)1

A series of laboratory experiments designed to illustrate the principle discussed on 84-136 and train the student in the techniques of experimentation. Prerequisite: 84-135 and 84-137. Corequisite: 84-136.

84-207 INORGANIC CHEMISTRY I(3,0)3

The chemical behavior, structure, and methods of preparation and nomenclature of the more common elements and their compounds. Prerequisite: 84-122, 84-124, or 84-136, 84-138

84-209 INORGANIC CHEMISTRY LABORATORY I I(1,3)2

A computation and laboratory course with the purpose of obtaining increased experience with equilibrium calculations, to study the reaction chemistry of ions in aqueous solution, and to carry out inorganic syntheses and characterizations. Prerequisite: 84-122. Corequisite: 84-207.

84-221 ORGANIC CHEMISTRY IA I(3,0)3

The basic principles and reactions which characterize the behavior of carbon compounds. Nomenclature and mechanism of reaction of many classes of chemical species will be covered. Emphasis is on broad aspects of theory by which the facts of organic chemistry can be deduced. Primarily for chemistry and biology majors. Prerequisite: 84-122 or 84-136; Corequisite: 84-227 or 84-229. Required for chemistry majors.

84-222 ORGANIC CHEMISTRY IIA II(3,0)3

A continuation of 84-221. Required for chemistry majors. Prerequisite: 84-221; Corequisite: 84-228 or 84-230.

84-223 ORGANIC CHEMISTRY I I(3,0)3

Discussions of the chemistry of organic compounds with emphasis on nomenclature, synthesis, reactions and reaction mechanisms, and applications of these in situations of laboratory, biological and industrial importance. An introduction to some basic principles of polymer chemistry will be interwoven into the presentation of the course. Primarily for, but not limited to, plastics engineering students. Prerequisite: 84-122 or 84-136. Corequisite: 84-225 or permission of instructor.

84-224 ORGANIC CHEMISTRY II II(3,0)3

A continuation of the first semester subject 84-223. Prerequisite: 84-223; corequisite: 84-226 or permission of instructor.

84-225 ORGANIC CHEMISTRY LABORATORY I I(0,4)1

Laboratory work in this course is scheduled to accompany topic presentations in the lecture phase of the course (84-223), with emphasis on organic laboratory techniques, equipment and procedures. Corequisite: 84-223.

- 84-226 ORGANIC CHEMISTRY LABORATORY II II(0,4)1
A continuation of the first semester laboratory course, 84-225. Prerequisite: 84-225; corequisite: 84-224.
- 84-227 ORGANIC CHEMISTRY LABORATORY I I(0,4)1
The laboratory work consists of practice in planning and carrying out reactions to form products isolable by distillation. Primarily for chemistry majors and students interested in intensive laboratory training. Corequisite: 84-221. Required for chemistry majors.
- 84-228 ORGANIC CHEMISTRY LABORATORY II II(0,4)1
The laboratory work consists of instruction and practice in planning and successfully carrying out reactions to form solid products isolable by crystallization. Primarily for chemistry majors and students interested in intensive laboratory training. Prerequisite: 84-227; Corequisite: 84-222. Required for chemistry majors.
- 84-229 ORGANIC CHEMISTRY IA I(0,4)1
Techniques, skills, and heuristic approaches in the synthesis, purification, and identification of organic compounds. IR, GC, and NMR instrumental methods included. Corequisite: 84-221.
- 84-230 ORGANIC CHEMISTRY IIA I(0,4)1
A continuation of 84-229. Prerequisite: 84-229; Corequisite: 84-222.
- 84-252 NUTRITION I(3,0)3
A study of the science of food, the nutrients and other substances therein, their action, interaction and balance in relation to health and disease and the chemical processes by which the nutrients are digested, absorbed, transported, and utilized to maintain good health. Prerequisite: 84-112 or 35-252.
- 84-300 DIRECTED STUDIES IN CHEMISTRY I II(0,3-6)1
An introduction to techniques of research. Open on to chemistry majors. Credit does not count toward those for A.C.S. certification nor toward the total of 122 credits for graduation. Prerequisite: 4 semesters of college level chemistry with laboratory, and permission of instructor.
- 84-313 ANALYTICAL CHEMISTRY I I(3,0)3
This course will focus on the evaluation of analytical data, aqueous and non-aqueous acid-base systems, oxidation reduction and complexation equilibria, solubility and precipitation, solvent extraction, ion-exchange and chromatographic methods. Prerequisite: 84-344; Corequisite: 84-315.
- 84-314 ANALYTICAL CHEMISTRY II II(3,0)3
The course will introduce the student to modern instrumental methods of chemical analysis. Included are such topics as ultraviolet-visible, infrared, emission and atomic absorption spectroscopy. The principles and applications associated with mass spectrometry, thermal and electrochemical methods of analysis, chromatographic techniques such as GC and HPLC will also be presented. This course is required for chemistry majors and is strongly recommended for students in the M.S. and Ph.D. programs in Environmental studies with permission of the instructor. Prerequisite: 84-313, and 95-202 or 95-245; Corequisite: 84-316.
- 84-315 ANALYTICAL CHEMISTRY I LABORATORY I(4,0)1
Experiments emphasizing the topics presented in 84-313 will be conducted. Corequisite: 84-313.
- 84-316 ANALYTICAL CHEMISTRY II LABORATORY II(4,0)1
Laboratory experiments are designed to complement the coverage of topics in 84-314. Prerequisites: 84-313, 84-315; Corequisite: 84-314.
- 84-321 ORGANIC SYNTHESIS LABORATORY I(1,6)3
This course involves more advanced laboratory work in organic chemistry with emphasis on modern techniques of synthesis and the use of instrumentation. Prerequisite: 84-222 or 84-224.
- 84-324 PRINCIPLES OF ANALYTICAL CHEMISTRY I or II(3,0)3
This course is designed to introduce engineering and science (other than chemistry) majors to the theory of gravimetric, volumetric, spectroscopic, and chromatographic analysis. Not open to student who have taken 84-314, 84-316, 84-313, or 84-315. Prerequisites: 84-122 or 84-136, and 92-131; Corequisite: 84-325.
- 84-325 PRINCIPLES OF ANALYTICAL CHEMISTRY LABORATORY I or II(0,4)1
The laboratory work is designed to parallel the lecture topics in 84-324, with a particular emphasis on practical

and applied conventional analytical analysis such as gravimetric, titrimetric, and spectroscopic analyses. Prerequisite: 84-123 or equivalent; Corequisite: 84-324.

84-334 ADVANCED INORGANIC CHEMISTRY II(3,0)3

An introduction to modern theories of atomic structure and chemical bonding, with emphasis on physical-chemical principles and properties. Considerable time will be spent on Coordination Compounds including topics such as descriptive chemistry, biochemical importance, and ligand field theory. Prerequisite: 84-345.

84-339 PHYSICAL CHEMICAL PRINCIPLES II(3,0)3

A one-term course designed for plastics technology majors. Emphasis is on aspects of physical chemistry of importance to polymer science: thermodynamics, solutions, kinetics, and optical methods of analysis. Prerequisites: 84-122 or 84-136, 92-231 or 92-233.

84-341 PHYSICAL CHEMICAL PRINCIPLES LABORATORY II(0,3)1

Laboratory work designed to exemplify principles and applications covered in 84-339. Corequisite: 84-339.

84-342 ORGANIC QUALITATIVE ANALYSIS II(1,6)3

Methods of identification and characterization of unknown organic substances whose properties have been previously published in the chemical literature. Prerequisite: 84-222 or 84-224.

84-344 PHYSICAL CHEMISTRY I II(3,0)3

The 84-344-345 sequence covers basic physical chemical topics: laws of thermodynamics, solutions, chemical and phase equilibria, electro-chemistry, kinetics, and atomic and molecular structure. Required for chemistry majors. Prerequisites: 92-231 or 92-233, 84-122 or 84-136.

84-345 PHYSICAL CHEMISTRY II I(3,0)3

See 84-344. Required for chemistry majors. Prerequisite: 84-344.

84-346 PHYSICAL CHEMISTRY LABORATORY I II(0,3)1

Laboratory work designed to exemplify principles covered in 84-344. Corequisite: 84-344. Prerequisite: 84-124 or 84-138. Required for chemistry majors.

84-347 PHYSICAL CHEMISTRY LABORATORY II I(0,3)1

Laboratory work designed to exemplify principles of chemical kinetics, equilibrium and spectroscopy. Prerequisite: 84-346; Corequisite: 84-345.

84-350 PHYSICAL BIOINORGANIC CHEMISTRY LABORATORY I(1,3)2

Coordination compounds are utilized in a core of experiments to illustrate basic physiochemical techniques and analysis of experimental data in electrochemistry and kinetics. A project lab is carried out to apply and extend techniques learned. Prerequisites: 84-344 and 84-346 or other laboratory experience in thermodynamics; Corequisite: 84-345.

84-402 COLOR SCIENCE I(2,3)3

An analytical course in which the concepts and methods of absorption are reflectance spectrophotometry and applied to the measurement of color perception, color difference, and the prediction of color matching. Encompasses both theoretical and applied practical methods for determining both qualitative and quantitative composition of the color producing components in transparent and opaque substratum such as liquids, paper, plastics, and textiles. Instrumental and computer usage for measuring and calculating trichromatic coefficients, color differences and color matching formulations are employed. Prerequisites: 84-313 and 84-222, or 84-224; permission of instructor.

84-403 INTRODUCTION POLYMER SCIENCE I I(3,0)3

An introduction to the physical chemistry of polymers, including molecular weight distribution and averages, polymer solutions, fractionation, methods of molecular determination, and structure and properties in the rubbery, glassy and crystalline states. Prerequisites: 84-222 or 84-224, 84-345 or 84-336.

84-404 INTRODUCTORY POLYMER SCIENCE II II(3,0)3

Step and chain growth polymerizations. Kinetics and mechanism. Copolymerization. Ionic and free radical polymerizations. Industrially important polymers. Prerequisites: 84-222 or 84-224, 84-345 or 84-336.

84-405 POLYMER LABORATORY I**II(0,4)1**

An introductory laboratory in polymer science concerned with the physical and chemical characterization of polymers. Prerequisites: 84-222 or 84-224, 84-345.

84-406 POLYMER LABORATORY II**II(0,4)1**

An introductory laboratory in polymer science concerned with the techniques of polymer synthesis. Prerequisites: 84-222 or 84-224, 84-345.

Theses

Credit for undergraduate thesis in chemistry (84-407-408) may be used by chemistry majors for credit and as a chemistry elective only when the thesis is under the direction and direct supervision of a member of the Chemistry Faculty. Interdisciplinary research may be used for chemistry credit only when the thesis is under the direct supervision of a member of the Chemistry Faculty, such that the second department involved is in an advisory role or supportive role. When those roles are reversed, or when research is done principally or totally under the direction of a faculty member of another department, the undergraduate research must be taken under the auspices of the other department involved using the corresponding undergraduate research course numbers for that department. The course may then be used as a general elective in the chemistry major program. However, only six credits in any undergraduate research experience will be applied to an academic program in chemistry for graduation credit. In the case of interdisciplinary research, where one semester is to be done in another department, a total of six credits for the year may be counted toward graduation with the stipulation that the second semester of research is a continuation of the first semester. In this special case, the student would be receiving three chemistry credits and three elective credits for undergraduate research.

84-407 UNDERGRADUATE THESIS I**I(0,9-12)3**

Research in biochemistry, electrochemistry or analytical, organic, inorganic, physical, or polymer chemistry. Progress report required. Prerequisite: permission of department chairperson and thesis supervisor. For credit for ACS certification, 84-407 must be followed by 84-408.

84-408 UNDERGRADUATE THESIS II**II(0,9-12)3**

A continuation of 84-407. Both semesters must be taken and not more than six credits may be used in meeting degree requirements. A written thesis and seminar are required. The written thesis is to follow the conventional form of introduction, literature survey, data, results, and conclusions. One copy of the thesis must be filed in the department office. Prerequisite: permission of department chairperson and thesis supervisor.

84-419 BIOCHEMISTRY**I(3,0)3**

A study of the chemistry of biomolecules including thermodynamics, kinetics and mechanism of enzyme action, intermediary metabolism and selected topics in molecular biology. Prerequisites: 84-222 or 84-224; 84-344 or equivalent.

84-421 BIOCHEMISTRY LABORATORY**I(0,4)1**

Laboratory experiments designed to acquaint the student with modern techniques in biochemistry and to emphasize material covered in 84-419. Corequisite: 84-419 or permission of instructor.

84-423 ADVANCED ORGANIC CHEMISTRY**I(3,0)3**

Extension of introductory organic chemistry. Organic reactions and compounds are discussed in terms of reaction mechanisms, structure-reactivity and stereochemistry. Prerequisite: 84-222 or 84-224.

84-424 ADVANCED ORGANIC CHEMISTRY**II(3,0)3**

Synthesis of organic molecules. Selected reagents and techniques are discussed with emphasis on the scope and limitations of these reactions. The reaction mechanisms are also discussed. Prerequisite: 84-423 or permission of instructor.

84-426 BIOINORGANIC CHEMISTRY**II(2,0)2**

An introduction to the role of metal ions in biological processes. Properties of metal ions will be discussed and how these contribute to a more detailed understanding of the biological systems in which they are involved. Prerequisite: 84-419 or equivalent.

84-434 COLLOID SCIENCE AND ITS ENVIRONMENTAL APPLICATIONS**II(3,0)3**

An introduction to the fundamentals of colloid and interface science. Topics discussed include solid/gas, solid/li-

quid, and liquid/liquid interfaces; association colloids, emulsion suspensions, aerosols and foams. Additional topics include applications of colloid science to environmental problems, flocculation and stability, adsorption and ion exchange, ultrafiltration, reverse osmosis, and electro-kinetic phenomena. Prerequisite: permission of instructor.

84-451 CHEMISTRY OF FOSSIL FUELS-COAL AND OIL SHALE (3,0)3

Topics considered include: origin of coal as interpreted from composition and chemical structure; abundance, location, and economic time scale for source depletion of each rank of coal; processes of desulfurization, denitrogenation, peptization, gasification, liquefaction, hydrogenation, partial oxidation, catalysis, and catalytic processes for refining coal. Coal utilization and its economics will be considered at appropriate times. The nature of oil shale and its use as a source of energy and chemicals will be considered in detail. Prerequisites: 1 semester physical chemistry and 84-222 or 84-224, or permission of professor.

84-452 CHEMISTRY OF FOSSIL FUELS-PETROLEUM AND NATURAL GAS (3,0)3

Topics considered include: origin of petroleum and natural gas, development of production and distribution technology related to contemporary events, source abundance and location, economic time scale for source depletion, refining processes, catalysis and catalytic processes, and utilization of products as fuels and chemicals. Selected chemical reactions and processes of the petrochemical industry are considered in detail. Prerequisites: 1 semester physical chemistry and 84-222 or 84-224, or permission of instructor.

84-484 ELEMENTS OF RADIOCHEMISTRY II(2,3)3

Chemical principles are reviewed and their applications to radioactivity are discussed. Laboratory experiments are oriented to the use of common separation procedures such as ion-exchange, isotopic precipitation and paper chromatography, for a better understanding of the role of chemistry in the study of radioisotopes. Prerequisites: 84-122 and 84-124 or 84-136 and 84-138.

Primarily for Graduate Students

All graduate courses are open to undergraduate students with permission of instructor.

84-513 SPECTROSCOPY II(3,0)3

A theoretical and practical interpretation of molecular spectra and an introduction to lasers and their applications to spectroscopy.

84-514 ADVANCED ANALYTICAL CHEMISTRY I or II(3,0)3

This course is to provide graduates and undergraduate (seniors and juniors) working knowledge in various fields of analytical chemistry. Fundamentals and applications are equally emphasized. Lecture topics include statistics, sampling theories, equilibrium calculations, spectroscopic methods for quantitation and molecular structure elucidation, and chemical separations. This course is also strongly recommended for students in the M.S. and Ph.D. programs in Environmental Studies. Prerequisite: Permission of Instructor or 84-314.

84-515 CHEMICAL LITERATURE I(1,2)2

Use of the chemical library, journals, reference works, patents and other technical publications pertaining to chemical subjects. Exercises are given in finding, assembling and using data found in the literature. The student will also be expected to assimilate the use of automated information retrieval and conduct computer assisted literature searches.

84-516 ADVANCED LABORATORY TECHNIQUE II(1,6)3

A study of the theory and application of the more advanced techniques and equipment in the preparation and purification of organic and inorganic compounds including high efficiency vacuum distillation, hydrogenation reactions in inert atmospheres. The student will be expected to master analytical techniques which involve the "hands-on" use of i.r. nmr, glc, tlc and other instrumental methods of product identification. Prerequisites: 84-523 and permission of instructor.

84-517 GLASS WORKING I(1,3)1

Fundamental techniques in the preparation and assembling of glass apparatus. The student will practice the art and science of scientific glass blowing. Skill in the assembly of simple scientific glass apparatus will be stressed. Open to all students with permission of instructor.

84-519 ENVIRONMENTAL CHEMISTRY I or II(3,0)3

The course topics will be aimed at all science majors and are designed to show the chemistry of various environmental problems. Air, soil and water pollution, mechanisms of pollutant transport and chemical changes of

pollutants will comprise the major portion of the semester. The remainder of the semester will concern itself with special topics such as nuclear energy, energy sources, water purification etc. A semester-long environmental sampling term project will expose the student to real problems in environmental analysis. Prerequisites: 84-314 or equivalent; 92-134 or equivalent (with permission of instructor).

84-521 PHYSICAL ORGANIC CHEMISTRY

I(3,0)3

Modern and classical methodology in the study of organic reactions. Fast reactions, linear free energy relationships, instrumental techniques, and other selected topics will be covered. Prerequisite: 84-523, 84-524 or equivalent. Offered in alternate years.

84-523 ORGANIC REACTION MECHANISMS AND STRUCTURES

I(3,0)3

Designed to provide insight into how reactions occur and how reaction mechanisms are studied. Emphasis is placed on bonding, structure and reactivity, conformational analysis and stereoelectronic effects.

84-524 ORGANIC SYNTHESIS

II(3,0)3

Mechanism, scope and limitations of important selected types of reactions and design of synthetic sequences. Emphasis is placed on methodology of synthesis and current literature. Prerequisite: 84-523 or permission of instructor.

84-526 CHROMATOGRAPHIC SEPARATIONS

I or II(3,0)3

A treatment of the theory underlying chromatographic methods of separation such as gas chromatography (GC), high pressure liquid chromatography (HPLC), thin layer chromatography (TLC) and paper chromatography. Also aspects related to membrane separations and field flow fractionation will be presented. This course is strongly recommended to graduate students in the Analytical Chemistry and Environmental studies programs. Prerequisite: 84-344 or permission of instructor.

84-527 STEREOCHEMISTRY

I(3,0)3

The fundamental concepts of symmetry and optical activity. The relationship of stereostructures to the physical and chemical properties of organic compounds. Offered in alternate years. Prerequisite: 84-523 and 84-524 or equivalent.

84-531 STATISTICAL THERMODYNAMICS

(3,0)3

Fundamentals of equilibrium statistical mechanics, classical and quantum statistics. Molecular theories of gases, crystals, and liquids, with emphasis on chemical aspects. Electrolyte and non-electrolyte solutions, polymer and polyelectrolyte systems, chemical equilibria and reaction rate processes. Also, an introduction to nonequilibrium statistical theorems. Prerequisite: 84-532 or equivalent.

84-532 ADVANCED PHYSICAL CHEMISTRY

(3,0)3

Extension of introductory physical chemistry. Open to seniors and first year graduate students in chemistry and related fields. Emphasis is placed on quantum chemistry of atoms and molecules as well as on classical and statistical thermodynamics. Prerequisite: Permission of instructor.

84-534 QUANTUM CHEMISTRY

I or II(3,0)3

Principles and methods of quantum mechanics with special attention to chemical applications; such as electronic structure of atoms and molecules, vibrations and rotation of molecules, and interaction of radiation and matter. Prerequisite: 84-532 or equivalent.

84-535 ADVANCED TOPICS IN PHYSICAL CHEMISTRY

I(3,0)3

Selected topics and recent advances in physical chemistry. Selection of topics is at the discretion of the instructor. Prerequisite: permission of instructor

84-536 ADVANCED TOPICS OF PHYSICAL CHEMISTRY

II(3,0)3

Same as 84-535 with different topics. Prerequisite: Permission of instructor.

84-538 BIOCHEMICAL MECHANISMS

II(3,0)3

Selected biochemical reactions will be presented from the point of view of organic reaction mechanisms. Enzyme Kinetics and theories of enzyme catalysis will be discussed. Mechanisms of coenzyme and enzyme catalysis are emphasized.

84-540 CHEMICAL KINETICS

II(3,0)3

The theoretical and empirical treatment of chemical kinetic data as well as the methods of obtaining these

data. Determination of the order of reactions, factors influencing rates, application of rate studies in establishing hypotheses for reaction mechanisms, collision theory, and absolute rate theory. Prerequisite: 84-345 or equivalent.

85-543 MODERN INORGANIC CHEMISTRY I(3,0)3
A theoretical treatment of atomic structure and chemical bonds, included are such topics as Russell Saunders' coupling, Molecular Orbital Theory, ligand field theory, and descriptive coordination chemistry. Prerequisite: one year of physical chemistry.

84-544 CHEMICAL APPLICATION OF GROUP THEORY II(3,0)3
Classification of molecules into point groups. Properties of groups as applied to chemical systems. Development of the ligand field theory and prediction of electronic and vibration-rotational spectra. Prerequisite: 84-334, 84-534 or equivalent.

84-563 Chemistry of Natural Products I(3,0)3
This course will cover the proof of structure of various types of natural products, approaches to the total synthesis of these products and also the biosynthetic pathways. Offered in alternate years. Prerequisites: 84-524 or 84-568 or equivalent.

84-564 ORGANIC QUALITATIVE ANALYSIS II*1,6)3
Similar to 84-342 but designed for graduate students majoring in chemistry. Prerequisite: 84-222 or equivalent.

84-565 HETEROCYCLIC CHEMISTRY I(3,0)3
Classification, nomenclature, structure, synthesis and utility of the more important classes of heterocyclic compounds. Offered in alternate years. Prerequisite: 84-524 or equivalent.

84-568 STRUCTURAL ANALYSIS II(3,0)3
Practical applications of instrumental data in the determination of the structure of organic compounds and polymers. Includes mass spectrometry, ultra-violet spectroscopy, infrared spectroscopy and nuclear magnetic resonance spectroscopy. Open to undergraduate and graduate students. Prerequisite: 84-222 or equivalent.

84-585 NUCLEAR CHEMISTRY I or II(3,0)3
Fundamentals of the dynamics of nuclear particle interactions and the structure of the nucleus will be the first part of the course material. Radioactive decay laws, nuclear reactions, radiochemical reactions, and activation analysis make up the remainder of the course work. Prerequisites: 84-345 and 92-231.

84-586 NUCLEAR CHEMISTRY LABORATORY I or II(0,4)1
This laboratory introduces the student to the many different types of nuclear instrumentation available. In addition radiochemical separations using solvent extraction, oxidation-reduction, ion-exchange, and gravimetry are performed to give the student experience in these special techniques as applied to radioactive materials. Corequisite: 84-585.

Polymer Chemistry (Course Prefix: 97)

Course offerings in polymer chemistry are primarily for graduate students but are open to undergraduates with the permission of the instructor.

97-503 POLYMER SCIENCE I (3,0)3
Introduction to chain statistics and thermodynamics of macromolecular solutions, methods of study of molecular weight and chain conformations, and the properties of polymers in bulk including viscoelasticity and crystallinity. Prerequisite: permission of instructor.

97-504 POLYMER SCIENCE II (3,0)3
A study of the principles of condensation, free radical, ionic, coordinating and ring-opening polymerization. The topics include the concepts of step-growth and chain-growth polymerization, the effect of polymerization technique on reaction kinetics and molecular weight and molecular weight distribution, and the evaluation of reactivity ratios in copolymerization reactions. Prerequisite: permission of instructor.

97-505 POLYMER PREPARATION AND CHARACTERIZATION I (0,4)1
An advanced laboratory in polymer science concerned with the synthesis and characterization of macromolecules. Prerequisite: permission of instructor.

- 97-506 POLYMER PREPARATION AND CHARACTERIZATION II (0,4)1
An advanced laboratory in polymer science concerned with the synthesis and characterization of macromolecules. Prerequisite: permission of instructor.
- 97-511 BIOPOLYMERS (3,0)3
Topics include conformation and configuration of vinyl polymers and polypeptides, energetics of chain folding and examination of the forces dictating ordered structures, helix to coil transitions in biopolymers with emphasis on polypeptide structures, instrumental analysis of biopolymer conformation, synthesis of biopolymers including polypeptides, polysaccharides and polynucleotides, and examination of relationships between synthetic polymers and naturally occurring polymers. Prerequisite: permission of instructor.
- 97-512 PROPERTIES OF BULK POLYMER (3,0)3
Structure and properties of bulk polymers in the glassy, rubbery, and crystalline states. Topics covered include chain statistics, rubber elasticity, crystalline polymers, glass transition, segmental motion and viscoelasticity. Prerequisite: permission of instructor.
- 97-549 PHYSICAL CHEMISTRY OF MACROMOLECULES I(3,0)3
Physical Chemistry of polymers including structure and conformation, chain statistics, molecular weight distributions and averages, polymerization kinetics and classical and statistical thermodynamics of polymer systems including polyelectrolytes. Prerequisite: 97-503 or equivalent.
- 97-550 PHYSICAL CHEMISTRY OF MACROMOLECULES II (3,0)3
Optical and hydrodynamic properties of polymer solutions. Methods of determination of structural parameters, including light scattering, viscometry, and other techniques. Prerequisite: 97-503 or equivalent.
- 97-553 ORGANIC CHEMISTRY OF MACROMOLECULES (3,0)3
An advanced study in polymer science concerned with the synthesis of macromolecules and their mechanisms of formation. Prerequisite: 97-503, 97-504.

DEPARTMENT OF COMPUTER SCIENCE

Thomas Costello, Chairperson

Professors: Thomas Costello, David Korff, Patrick Krolek, Robert Lechner, Giampiero Pecelli

Associate Professors: Shimshon Berkovits, William Moloney

Assistant Professors: Ovais Ghaznavy, Myra Prella, Charles Steele

Instructor: Charles Ryan, John Sieg.

The Department of Computer Science offers a major in computer science which leads to the degree of Bachelor of Science in Computer Science.

Computer Science Major

Computer Science is the study of those problems that are best solved by means of a computer. The goal of the curriculum in computer science is to provide the student with the appropriate tools to identify such problems and to design and implement effective, economical and creative solutions for them.

The required courses in the curriculum give the student a strong foundation in both the software and hardware aspects of computing, as well as the mathematics and physics which underlie the discipline. The electives in the senior year allow the student to study more deeply some particular area of computer science. The background elective requirement provides the student with a four course sequence in an area of potential in depth application. Such diverse areas as mathematics, electrical and mechanical engineering, industrial management, psychology and music may be considered for the fulfillment of this requirement. Graduates of the Computer Science program will be prepared for employment in computer industries or in computer applications positions and to continue their study in a graduate program.

Due to the limited number of entering student that can be accepted into the Computer Science program, it is recommended that students should present SAT scores which are at least 450 in Verbal and 550 in Mathematics. In addition, students who have earned high grades in a laboratory science and/or a foreign language in high

school will be considered first for admission to the program. Beginning with the second semester of the freshman year, and every semester thereafter, each Computer Science major must maintain

- a) a semester average of 2.3 or better in required major courses including approved electives.
- b) a semester average of 2.0 or better in all courses.

Students who fail to satisfy these requirements will have their records reviewed by a faculty committee and, in the absence of unusual circumstances, will be dropped from the Computer Science program.

Summary of Degree Requirements

I	University Core Requirements*	35
	Physical Education	2
	English Composition	6
	Area I (Behavioral & Social Sciences)	6-9
	Area II (Fine Arts & Humanities)	6-9
	Area III (Mathematics & Sciences) +	9-12 +

* A minimum of two course and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Nine credits towards Area III requirements are satisfied by specified mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics. Students should consult the section on University Core Requirements for details on how the remaining 18 required credits may be distributed.

* A revised University core requirement will apply to the freshman class entering in September 1983, and thereafter. Cf. "University Core Requirement" in the *University Academic Policies* section of this bulletin.

II	Major Requirements	87 (89)
	A. Computer Science	42
	91-101 Introduction to Computing & Lab	4
	91-102 Introduction to Data Structures	4
	91-202 Data Structures and Algorithms	3
	91-203 Assembly Language Programming	4
	91-208 Survey of Programming Languages	3
	91-307 Introduction to Data Base Management	3
	91-305 Computer Architecture	3
	91-308 Introduction to Operating Systems	3
	Computer Science Electives	15
	B. Supporting Engineering & Mathematics	33 (35)
	92-133 Calculus A-1 or	4
	92-131 Calculus B-1	(4)
	92-134 Calculus A-11 or	4
	92-132 Calculus B-11	(4)
	95-141 Physics I or	4
	95-145	(5)
	95-142 Physics II or	4
	95-145	(5)
	92-321 Discrete Structures I	3
	92-322 Discrete Structures II	3
	92-386 Statistics for Science & Engineering	3
	16-261 Digital Logic I	4
	16-262 Digital Logic II	4
	C. Background Elective Courses	12

III	Unrestrictive Elective Courses	15
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IV	Minimum Credit Requirement	126
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COURSE OF STUDY FOR COMPUTER SCIENCE (Bachelor of Science Degree)##

Freshman Year

92-131 Calculus or 133	4	92-132 Calculus II or 134	4
91-101 Intro. to Computing and Lab	4	91-102 Intro. to Data Structures	4
95-141 Physics I or 145	4 or 5	95-142 Physics II or 146	4 or 5
42-101 College Writing Phys. Ed.	3 1	42-101 College Writing Phys. Ed.	3 1
	16 or 17		16 or 17

Sophomore Year

92-321	Discrete Str. I	3	92-322	Discrete Str. II	3
91-203	Assembly Language Programming	4	91-208	Survey of Programming Languages	3
16-261	Digital Logic I	4	16-262	Digital Logic II	4
	Electives	4 or 6	91-202	Data Structures & Algorithms Elective (Area I/II)	3
		15 or 17			16

Junior Year

92-386	Statistics for Science & Eng.	3	91-308	Intro. to Operating Systems	3
91-305	Computer Architect.	3		Approved Elective (Computer Science)	3
	Background Elective	3		Background Elective	3
	Elective (Area I/II)	3		Elective (Area I/II)	3
91-307	Intro. to Data Base Management	3		Elective	3
		15			15

Senior Year

Approved Elective	3	Approved Elective	3
Approved Elective	3	Approved Elective	3
Background Elective	3	Background Elective	3
Elective (Area I/II)	3	Elective (Area I/II)	3
Elective	3	Elective	3
	15		15

##Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Computer Science (Course Prefix: 91)

91-101 INTRODUCTION TO COMPUTING AND LAB (3,3)4
Overview of computer organization. The Pascal language, data types and their representations, arithmetic and logical operations, simple I/O, control structures, subprograms, arrays, records and introduction to files. Problem solving via stepwise refinement, good programming style, documentation and testing.

91-102 INTRODUCTION TO DATA STRUCTURES (3,3)4
Recursion and dynamic data structures in Pascal. String processing. Searching and sorting methods. Hash coding. Linear storage allocation (e.g., stacks, queues) and linked allocation (e.g., linked lists, trees). Problem solving via stepwise refinement, good programming style, documentation and testing. Prerequisite: 91-101.

91-202 DATA STRUCTURES AND ALGORITHMS (3,1)3
A development of more sophisticated ideas in data type and structure, with an introduction to the connection between data structures and algorithms supported. Data abstractions; controlled access structures; trees, lists, graphs, arrays; elementary consideration of algorithm design strategy: backtracking, greedy strategy, divide and conquer, branch and bound; elementary techniques for analysis: recursion equations, estimation methods, elementary combinatorial arguments. Examination of problem areas such as searching, sorting, shortest path, matrix and polynomial operations and the indicated representations and algorithms. The student will be expected to use the techniques learned in this course and in previous courses to solve a number of logically complex programming problems. Prerequisites: 91-102, 91-203, 92-321. Corequisites: 91-208, 92-322.

91-203 ASSEMBLY LANGUAGE PROGRAMMING (3,3)4
Principle machine instruction types and their formats, character representation, program control, fetch-execute cycle, timing, I/O operations. Mnemonic operations, symbolic addresses, instruction format, data-word definition, literals, location counter, error flags and messages. Indexing, indirect addressing, absolute and relative addressing. Macro definition, call, parameters, expansion and nesting. File control, I/O specification statements and device handlers, data buffering and blocking, interrupts, subroutines and coroutines. One and two pass assemblers, prelocation, relocatable loaders, simulators and traces. Prerequisite: 91-102.

91-208 SURVEY OF PROGRAMMING LANGUAGES (3,1)3
A survey of several programming languages such as ALGOL, COBOL, FORTRAN, PL/I, LISP, APL, ADA, C, SNOBOL, FORTH. Review of basic data types, constructs for specifying and manipulation of data types, language features effecting static and dynamic data storage management. Language constructs for specifying program control and data transfer, subroutines, procedures, functions, block structures and interrupts, decision tables, recursion, string processing and vector processing features. Run-time considerations and their relationship

with various language features. Compilation vs. interpretation. Prerequisites: 91-102, 91-203, 92-321. Corequisites: 91-202.

91-250 - 91-259 SELECTED TOPICS variable credit 1-3
Depending on faculty interest and student demand. May include: COBOL, PL/I, ADA, SIMSCRIPT. Prerequisite: Sophomore status.

91-305 COMPUTER ARCHITECTURE (3,0)3
A functional examination of the basic components of a computer system including the CPU, memory systems and I/O systems. Each of these 3 areas will be developed in detail with a focus on system design and component integration. Topics will include CPU control and ALU operation, computer timing, data address and I/O bus activity, addressing model, programmed and DMA I/O, and instruction sets and micro-code. Prerequisite: 91-203, 16-262.

91-306 INTRODUCTION TO COMPILER WRITING (3,0)3
Formal language concepts including syntax and basic characteristics of grammars, Bachus Naur Form. Lexical analysis, top-down and bottom-up parsing. Prerequisite: 91-208, 92-322.

91-307 INTRODUCTION TO DATA BASE MANAGEMENT (3,1)3
File organization including sequential, indexed sequential, direct access. Introduction to data base management schemes: relational, indexed hierarchical, network models and management schemes. Information retrieval languages. Comparisons of existing data base management systems. Prerequisite: 91-202, 91-208, 92-322.

91-308 OPERATING SYSTEMS (3,0)3
Major operating systems issues and components will be introduced and developed including processes, concurrency and synchronization, deadlock, processor allocation, memory management, I/O devices and file management and distributed processing. Techniques in operating system design, implementation and evaluation will be examined. Prerequisite: 91-203, 91-208, 91-305.

91-350 - 91-359 SELECTED TOPICS variable credit 1-3
Depending on faculty interest, student demand and developments in the field. May include: File Management, Software Tools. Prerequisite: Junior status.

91-403 OPERATING SYSTEMS PRACTICUM (1,3)3
Construction of real operating systems. Topics will include case studies of systems such as UNIX, MULTICS, CP/M, etc., structured design and performance techniques. Group projects will be employed to design, build and evaluate various operating systems modules. Prerequisite: 91-203, 91-208, 91-308 and permission of instructor.

91-404 SYSTEMS PROGRAMMING (3,1)3
Issues in the functionality design and implementation of translation software. The focus is on assemblers, compilers, linkers and loaders. Topics will include the objective of program translation, one and two pass assemblers, macro processors, program modules, block structure, external resolution, program relocation, attribute binding and syntactic, lexical and semantic analysis. Prerequisite: 91-203, 91-208, 91-308.

91-407 COMPILER WRITING PRACTICUM (3,1)3
Run time storage organization, symbol tables, hash addressing and chaining, internal forms of the source programs. Semantic routines, their implementation and diagnostic allocation of storage to run-time variables, error recovery. Interpreters, global optimization, local code optimization. Translator writing system, translator performance, object code performance. Prerequisite: 91-306.

91-411 MANAGEMENT INFORMATION SYSTEMS (3,0)3
An analysis of information support systems which serve the manager user. An examination of management-related information systems to include: the definition, structure and need for such systems. Man-machine interface, development and project management methodologies. Case studies. Prerequisite: 91-307.

91-412 SOFTWARE ENGINEERING (3,0)3
The design and construction of software systems. System life-cycle. Modularity, portability, adaptability and reliability. Program verification and testing. Concurrency in software systems. Project management. Documentation. Security. Prerequisite: permission of instructor.

- 91-413 DATA COMMUNICATIONS (3,0)3
Classification of network topologies. Properties of communication channels. Line switching, message switching and packets. Prerequisite: 91-307.
- 91-414 DISTRIBUTED SYSTEMS (3,0)3
Prerequisite: 91-413.
- 91-415 OFFICE AUTOMATION (3,0)3
Office information and decision support systems. Data and records management, electronic filing and retrieving systems, word processing, telecommunications, local area networking. Prerequisite: 91-307.
- 91-420 ARTIFICIAL INTELLIGENCE (3,1)3
LISP, tree and graph searching algorithms: breadth first, depth first, uniform cost, heuristic search methods, admissibility. Games: mini-max, alpha-beta. Theorem proving and question answering. Prerequisite: permission of instructor.
- 91-421 ARTIFICIAL INTELLIGENCE SEMINAR (3,0)3
Other topics in artificial intelligence not covered in 91-420 such as computer vision, speech recognition, robotics, expert systems, computer art, computer music. Prerequisite: 91-420 and permission of instructor.
- 91-425 SYMBOLIC MATHEMATICAL COMPUTATION (3,0)3
The use of computer algebra systems, such as MACSYMA, REDUCE. Algorithms for exact computation in: the integers, the ring of polynomials, finite fields, and rational function fields. Greatest common divisor algorithms and polynomial factorization algorithms. Transcendental function arithmetic, symbolic integration algorithms. Prerequisite: 91-202, 92-322 and permission of instructor.
- 91-427 COMPUTER GRAPHICS (3,0)3
Theory and technology of computer graphics, display devices and display processors; display files and transformations. Data structure considerations for computer graphics. Windowing, shading, perspective transformations. Graphics programming languages. Graphics system design. Vector, character, and curve generation. Prerequisite: 91-208 or 91-303, 91-322.
- 91-436 MODELING AND SIMULATION (3,0)3
Prerequisite: permission of instructor.
- 91-450 - 91-459 SELECTED TOPICS variable credit 1-3
Depending on faculty interest, student demand and developments in the field. May include: Computability, Formal Languages, Automata, VLSI Design, Computer Aided Design (CAD), Computer Aided Instruction, Semantics of Programming Languages. Prerequisite: Senior status.
- 91-490 DIRECTED STUDIES IN COMPUTER SCIENCE variable credit 1-3
Individual study for a student desiring more advanced or more specialized work. This course may not be taken more than twice and may not be substituted for scheduled offerings. Prerequisite: permission of instructor.

DEPARTMENT OF EARTH SCIENCES

Arnold L. O'Brien, Chairperson

Professor: Robert C. Curtis

Associate Professors: Nelson Eby, Richard Gore, Arnold L. O'Brien, Wen Tang

Instructor: Noel Ring

The Department of Earth Sciences offers major programs in environmental science and meteorology, and a minor area of study in geology. The meteorology major leads to the Bachelor of Science degree. The environmental science major is offered with two options; the first leads to the Bachelor of Arts degree and the second (with a geology option) leads to the Bachelor of Science degree.

Environmental Science Major

The major in environmental science is a broad-based, interdisciplinary program which is designed to provide students with an understanding of the complex inter-relationships which exist at the earth's surface. The pro-

gram, which is offered with options leading to the Bachelor of Arts or Bachelor of Science degrees, focuses on physical and biological systems, but also recognizes the related nature of social and economic studies. A major in environmental science will prove useful for students planning to pursue graduate work in environmental studies and in education or who wish to pursue environmentally oriented careers in business, government, and industry.

The Bachelor of Arts degree program is designed for students who wish to obtain a broad-based background in the sciences and related humanities and social sciences. A number of unrestricted elective courses permit maximum flexibility in designing a program of study which will satisfy personal goals within the context of individual competencies. Students pursuing the Bachelor of Arts degree program must complete a minimum of 45 credits and 15 courses from the offerings of the College of Liberal Arts, the College of Music, or the economics offerings of the College of Management Science.

For those students who are interested in geology, an option in this field is provided within the framework of the Bachelor of Science degree program. A major in environmental science with an option in geology will provide a basic foundation for subsequent studies in such subfields of applied geology as mineral exploration and exploitation, engineering geology, geologic hazard evaluation, and energy resource development. For the student possessing the necessary science competencies, a wide range of career opportunities is available. The employment picture for geologists is currently quite good, due to the demand for energy and non-energy resources, and is expected to remain strong during the decade of the 1980's. Students planning to pursue such career opportunities should recognize that training at the graduate level is required in most cases.

Summary of Degree Requirements (Bachelor of Arts)

I	University Core Requirements	23
	Physical Education	2
	English Composition	6
	Area I (Behavioral & Social Sciences)	6-9*
	Area II (Fine Arts & Humanities)	6-9*
	Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified science and mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics.

II	Major Field Requirements-	77-84
A	Environmental Sciences	25
	87-101: Introduction to Environmental Sciences	1
	87-124: Land Use Planning	3
	87-232: Atmospheric Science	3
	87-234: Atmospheric Science Laboratory	1
	87-401: Seminar in Remote Sensing of the Environment	3
	89-203: Oceanography	3
	89-205: Oceanography Laboratory	1
	89-213: Environmental Geology	3
	89-314: Hydrogeology	3
	81-315: Principles of Ecology	2
	81-317: Principles of Ecology Laboratory	2
B	Area of Focus	14-16
	Environmental science majors must elect a minimum of four courses (14 or more semester credits) from one of the following three categories:	
	1. Biological Aspects of Environmental Science	
	81-201: General Microbiology	3
	81-203: General Microbiology Laboratory	1
	81-215: Introduction to Marine Biology	2
	81-217: Introduction to Marine Biology Laboratory	1
	81-224: Introduction to Insect Biology	2
	81-226: Introduction to Insect Biology Laboratory	1
	81-228: Ornithology	2
	81-230: Ornithology Laboratory	1
	81-331: Quantitative Ecology	3
	81-333: Quantitative Ecology Laboratory	1
	81-335: Genetics	3
	81-337: Genetics Laboratory	1

81-422: Plant Physiology	3
81-424: Plant Physiology Laboratory	1
81-510: Limnology	3
81-512: Limnology Laboratory	1
82-354: Wildlife and Environmental Management	3
2. Geological Aspects of Environmental Science	
89-208: Paleontology	3
89-210: Paleontology Laboratory	1
89-251: Mineralogy	3
89-253: Mineralogy Laboratory	1
89-301: Optical Mineralogy	3
89-303: Optical Mineralogy Laboratory	1
89-304: Igneous and Metamorphic Petrology	3
89-306: Igneous and Metamorphic Petrology Laboratory	1
89-316: Geomorphology	3
89-318: Geomorphology Laboratory	1
89-322: Structural Geology	3
89-324: Structural Geology Laboratory	1
89-352: Stratigraphy and Sedimentation	3
89-354: Stratigraphy and Sedimentation Laboratory	1
89-452: Geochemistry	3
3. Chemical Aspects of Environmental Science	
84-207: Inorganic Chemistry	3
84-209: Inorganic Chemistry Laboratory	2
84-221: Organic Chemistry 1A	3
84-222: Organic Chemistry 11A	3
84-227: Organic Chemistry Laboratory I	1
84-228: Organic Chemistry Laboratory II	1
84-324: Principles of Analytical Chemistry	3
84-325: Principles of Analytical Chemistry Laboratory	1
84-344: Principles of Physical Chemistry I	3
84-346: Principles of Physical Chemistry Laboratory I	1
84-342: Organic Qualitative Analysis	3
84-484: Radiochemistry	3
C Supporting Sciences and Mathematics	38-43
1. 92-131: Calculus B-1 or 92-133: Calculus A-1 and two additional mathematical courses	10-12
2. 81-111, 113: Principles of Biology I and Laboratory and 81-112, 114: Principles of Biology II and Laboratory	8
3. 84-121, 123: Chemistry I and Chemistry I Laboratory plus 84-122, 124: Chemistry II and Chemistry II Laboratory	8
4. Two semesters of introductory physics	8-11
5. 89-121, 123: Physical Geology and Laboratory	4

III Elective Courses

Students pursuing the Bachelor of Arts Degree are required, at a minimum, to take 29 credits from the offerings of the College of Liberal Arts, the College of Music, or the economics offerings of the College of Management Science. These courses* are selected by students in accordance with their needs, talents, and interests and in consultation with their faculty advisors.

*Minor areas of study require a minimum of 6 credits at the 300-400 level.

IV Minimum Credit Requirement

129

-Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for degrees in the College of Pure and Applied Sciences.

Summary of Degree Requirements (Bachelor of Science) Geology Option

I University Core Requirements	23
Physical Education	2
English Composition	6
Area I (Behavioral & Social Sciences)	6-9*
Area II (Fine Arts & Humanities)	6-9*
Area III (Mathematics & Sciences)	(12) -

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirement. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified science and mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics.

II	Major Field Requirements-	92-96
A	Environmental Sciences	22
	87-101 Introduction to Environmental Sciences	1
	87-124 Land Use Planning	3
	87-232 Atmospheric Science	3
	87-234 Atmospheric Science Laboratory	1
	87-401 Seminar in Remote Sensing of the Environment or	
	89-495 Honors Research in Geology	3
	89-203 Oceanography	3
	89-205 Oceanography Laboratory	1
	89-314 Hydrogeology	3
	81-315 Principles of Ecology	2
	81-317 Principles of Ecology Laboratory	2
B	Geology Option	31
	89-208 Paleontology	3
	89-210 Paleontology Laboratory	1
	89-251 Mineralogy	3
	89-253 Mineralogy Laboratory	1
	89-301 Optical Mineralogy	3
	89-303 Optical Mineralogy Laboratory	1
	89-304 Igneous and Metamorphic Petrology	3
	89-306 Igneous and Metamorphic Petrology Laboratory	1
	89-316 Geomorphology	3
	89-318 Geomorphology Laboratory	1
	89-322 Structural Geology	3
	89-324 Structural Geology Laboratory	1
	89-352 Stratigraphy & Sedimentation	3
	89-354 Stratigraphy & Sedimentation Laboratory	1
	Geology Elective	
	89-326 Glacial and Pleistocene Geology or	
	89-431 Regional Geology or	
	89-452 Geochemistry or	
	89-454 Economic Geology	
C	Supporting Sciences and Mathematics	39-43
	1. 92-131: Calculus B-I or 92-133: Calculus A-I	
	92-132: Calculus B-II or 92-134: Calculus A-II, and one additional mathematics course	7-8
	2. 81-111, 113: Principles of Biology I and Laboratory	4
	81-112, 114: Principles of Biology II and Laboratory	4
	3. 84-121, 123: Chemistry and Chemistry Laboratory plus	4
	84-122, 124: Chemistry Principles and Laboratory	4
	4. 95-201, 202 and 96-201, 202: Principles of Physics and Laboratory or	8
	95-141, 144, 245 and 96-141, 144, 245: Physics and Laboratory	(11)
	5. 89-121, 123: Physical Geology and Laboratory	4
III	Unrestricted Elective Courses-	3-12
IV	Minimum Credit Requirement	122
-Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for degrees in the College of Pure and Applied Sciences.		

Geology Minor

A minor in geology consists of 89-121: Physical Geology and five courses from the following listing, two of which must be at the 300 course level or above.

- 89-208: Paleontology
- 89-251 Mineralogy
- 89-301 Optical Mineralogy
- 89-304 Igneous and Metamorphic Petrology
- 89-314 Hydrogeology
- 89-316 Geomorphology
- 89-322 Structural Geology
- 89-352 Sedimentation and Stratigraphy

Meteorology Major

The meteorology major is offered under the requirements of the College of Pure and Applied Sciences for the Bachelor of Science degree. The goal of the meteorology program is to provide students with a knowledge of the

fundamental principles and techniques of physics and mathematics which is necessary for understanding atmospheric behavior and for solving practical problems concerning weather and climate. Because meteorology is primarily the application of the principles and techniques of physical sciences to the study of the atmosphere, the meteorology curriculum specifies a substantial core of supporting science and mathematics courses.

The work of the meteorologist is concentrated on the effort to understand the physical causes of weather and climate and to apply this knowledge to the solution of practical problems ranging from the forecasting of weather to the analysis of the influence of weather and climate on public health, agriculture, engineering, industry and commerce, and national defense. Meteorologists are employed by the agencies of the federal government, the National Oceanic and Atmospheric Administration, the National Weather Service, and the Department of Defense, as well as by agencies of state and local governments, and by commercial aviation companies and private consulting firms. Meteorology students who wish to continue their studies at the graduate level are advised to develop competencies in science and mathematics, especially in Computer Science, beyond those which are mandated by the supporting science and mathematics core.

Summary of Degree Requirements

I	University Core Requirements	23
	Physical Education	2
	English Composition	6
	Area I (Behavioral & Social Sciences)	6-9*
	Area II (Fine Arts & Humanities)	6-9*
	Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified science and mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics.

II	Major Field Requirements#	82-84
A	Meteorology	37
	93-101 Seminar in Meteorology	1
	93-211 Elementary Meteorology I	3
	93-212 Elementary Meteorology II	3
	93-301 Atmospheric Dynamics I	3
	93-302 Atmospheric Dynamics II	3
	93-308 Synoptic Meteorology	3
	93-313 Physical Climatology	3
	93-403 Physical Meteorology	3
	93-415 Advanced Atmospheric Dynamics I	3
	93-416 Advanced Atmospheric Dynamics II	3
	93-421 Analysis and Forecasting I	3
	93-422 Analysis and Forecasting II	3
	93-430 Atmospheric Diffusion	3
B	Chemistry	8
	84-121 Chemistry	3
	84-123 Chemistry Laboratory	1
	84-122 Chemistry	3
	84-124 Chemistry Laboratory	1
C	Mathematics	25-27
	92-131 Calculus B-I	4
	92-133 Calculus A-I	(4)
	92-132 Calculus B-II	4
	92-134 Calculus A-II	(4)
	92-231 Calculus B-III	4
	92-233 Calculus A-III	(3)
	92-234 Differential Equations	3
	92-301 Applied Mathematics I	3
	92-302 Applied Mathematics II	31
	92-361 Digital Computer Programming	2
	92-383 Introduction to Statistics	3
D	Physics	12
	95-141 Physics I	3
	96-141 Fundamentals of Experimental Physics I	1
	95-144 Physics II	3

96-144 Fundamentals of Experimental Physics II	1
95-245 Physics III	31
96-245 Fundamentals of Experimental Physics III	1

III Science and Engineering Electives- 16-18

The Major Field Requirements permit students to elect limited programs for the purpose of developing specific interests. In consultation with their advisors, students may choose a minor, additional elective courses in meteorology, science, and mathematics, or may elect the following engineering courses as preparation for various fields allied with meteorology. A minimum of 6 credits at the 300 - 400 course levels is required for all minors.

14-301 Hydraulics	4
14-460 Water Resources Engineering	4
16-211 Fundamentals of Electricity	3
16-212 Introductory Electronics	3
22-242 Thermodynamics	3
22-343 Heat Transfer	3
22-382 Fluid Mechanics	3
22-483 Aerodynamics	3
18-523 Air Resources	3

IV Minimum Credit Requirement 123

*Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for degrees in the College of Pure and Applied Sciences.

SAMPLE COURSE OF STUDY FOR ENVIRONMENTAL SCIENCES (Bachelor of Arts Degree)#

Freshman Year

Fall Semester		Spring Semester	
42-101 College Writing	3	42-102 College Writing & Literature	3
84-121 Chemistry	3	84-122 Chemistry	3
84-123 Chemistry Laboratory	1	84-124 Chemistry Laboratory	1
92-131 Calculus B-I	4	87-124 Land Use Planning	3
89-121 Physical Geology	3	92 Mathematics Elective	3-4
89-123 Phys. Geol. Lab.	1	39 Physical Education	1
87-101 Introduction to Environmental Science	1		1
39 Physical Education	1		
17		17-18	

Sophomore Year

Fall Semester		Spring Semester	
81-111 Principles of Biology I	3	81-112 Principles of Biology II	3
81-113 Principles of Biology I Lab.	1	81-114 Principles of Biology II Lab.	1
95-201 Principles of Physics I	3	95-202 Principles of Physics II	3
96-201 Principles of Physics I Lab.	1	96-202 Principles of Physics II Lab.	1
89-213 Environmental Geology	3	89-314 Hydrogeology	3
92 Mathematics Elective	3-4	Elective (Area I or II)	3
Elective (Area I or II)	3	Elective (Liberal Arts)	3
17-18		17	

Junior Year

Fall Semester		Spring Semester	
89-203 Oceanography	3	87-232 Atmospheric Science	3
89-205 Oceanography Laboratory	1	87-234 Atmospheric Science Laboratory	1
81-315 Principles of Ecology	3	Elective (Focus)	4
81-317 Prin. of Ecology Lab	1	Elective (Area I or II)	3
Elective (Focus)	4	Electives (Liberal Arts)	6
Elective (Area I or II)	3		
15		17	

Senior Year

Fall Semester		Spring Semester	
87-401 Environmental Science Seminar	3	Elective (Focus)	3-4
Elective (Focus)	3-4	Electives (Liberal Arts)	12
Electives (Liberal Arts)	9		
15-16		15-16	

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

SAMPLE COURSE OF STUDY FOR ENVIRONMENTAL SCIENCES - GEOLOGY OPTION#

(Bachelor of Science Degree)

Freshman Year

Fall Semester		Spring Semester	
42-101 College Writing	3	42-102 College Writing & Literature	3
84-121 Chemistry	3	84-122 Chemistry	3

84-123 Chemistry Laboratory	I	84-124 Chemistry Laboratory	1
92-131 Calculus B-I	4	87-124 Land Use Planning	3
89-121 Physical Geology	3	92-132 Calculus B-II	4
89-123 Physical Geology Laboratory	1	Elective (Area I or II)	3
87-101 Introduction to Environmental Science	1	39 Physical Education	1
39 Physical Education	1		18
	17		

Sophomore Year

Fall Semester		Spring Semester	
81-111 Principles of Biology I	3	81-112 Principles of Biology II	3
81-113 Principles of Biology I Lab.	1	81-114 Principles of Biology II Lab.	1
95-201 Principles of Physics I	3	95-202 Principles of Physics II	3
96-201 Principles of Physics I Lab		96-202 Principles of Physics II Lab.	1
89-322 Structural Geology	3	89-315 Hydrogeology	3
89-324 Structural Geology Lab.	1	89-316 Geomorphology	3
92 Mathematics Elective	3-4	89-318 Geomorphology Laboratory	1
	15-16		15

Junior Year

Fall Semester		Spring Semester	
89-203 Oceanography	3	87-232 Atmospheric Science	3
89-205 Oceanography Laboratory	1	87-234 Atmospheric Science Laboratory	1
81-315 Principles of Ecology	3	89-301 Optical Mineralogy	3
81-317 Principles of Ecology Lab.	1	89-303 Optical Mineralogy Laboratory	1
89-251 Mineralogy	3	89-352 Sedimentation & Stratigraphy	3
89-253 Mineralogy Laboratory	1	89-354 Sedimentation & Stratigraphy Lab.	1
89-208 Paleontology		Elective (Area I or II)	3
89-210 Paleontology Laboratory	1		
	16		15

Senior Year

Fall Semester		Spring Semester	
87-407 Environmental Science Seminar	3	Geology Elective	3
89-304 Petrology	3	Elective (Area I or II)	3
89-306 Petrology Laboratory	1	Electives	9
Elective (Area I or II)	6		
Elective	3		
	16		15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

SAMPLE COURSE OF STUDY FOR METEOROLOGY (Bachelor of Science Degree)#

Freshman Year			
Fall Semester		Spring Semester	
84-121 Chemistry	3	84-122 Chemistry	3
84-123 Chemistry Laboratory	1	84-124 Chemistry laboratory	1
*92-131 Calculus B-I	4	*92-132 Calculus B-II	4
93-101 Seminar in Meteorology	1	95-144 Physics II	3
95-141 Physics I	3	96-144 Fundamentals of Experimental Physics II	1
96-141 Fundamentals of Experimental Physics	1	42-102 College Writing and Literature	3
42-101 College Writing	3	39 Physical Education	1
39 Physical Education	1		
	17		16

Sophomore Year

Fall Semester		Spring Semester	
*92-231 Calculus B-III	4	*92-234 Differential Equations	3
92-361 Digital Computer Programming	2	92-383 Introduction to Statistics	3
92-211 Elementary Meteorology	3	93-212 Elementary Meteorology	3
95-245 Physics III	3	Elective (Area I or II)	3
96-245 Fundamentals of Experimental Physics III	1	Elective (Science or Engineering)	3-4
Elective (Area I or II)	3		
	16		15-16

Junior Year

Fall Semester		Spring Semester	
92-301 Applied Mathematics I	3	92-302 Applied Mathematics II	3
93-301 Atmospheric Dynamics	3	93-302 Atmospheric Dynamics	3
93-308 Synoptic Meteorology	3	93-313 Physical Climatology	3
Elective (Area I or II)	3	Elective (Area I or II)	3
Elective (Science or Engineering)	3-4	Elective (Science or Engineering)	3-4
	15-16		15-16

Senior Year					
Fall Semester			Spring Semester		
93-403	Physical Meteorology	3	93-416	Advanced Atmospheric Dynamics II	3
93-415	Advanced Atmospheric Dynamics I	3	93-422	Analysis and Forecasting	3
93-421	Analysis & Forecasting	3	93-430	Atmospheric Diffusion	3
	Elective (Area I or II)	3		Elective (Science or Engineering)	3-4
	Elective (Science or Engineering)	3-4		Elective	3
		15-16			15-16

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Cf. Summary of Degree Requirements for listings of approved alternative courses.

Environmental Sciences (Course Prefix: 87)

87-101 INTRODUCTION TO ENVIRONMENTAL SCIENCE I(2,0)1
A survey of the field of Environmental Science. Topics considered include air, water, and noise pollution; solid and liquid waste disposal; and social, political, and economic implications of these problems. Readings, discussions, guest speakers, and field trips will be utilized. Only for Environmental Science majors.

87-102 FOUNDATIONS OF CONSERVATION AND ENVIRONMENTAL CONCERN I,II(3,0)3
A study of the evolution of American environmental perception. Topics include a historical review of the changes in federal land policy, and the contributions of naturalists, scientists and laymen toward establishing a concern for environmental quality.

87-111 INTRODUCTION TO THE ENVIRONMENT I(3,0)3
A general survey of the areas of the environmental concern. Topics include man's impact on ecosystems; human population growth; use and depletion of natural resources; nuclear power and other energy sources; modern agriculture and the use of pesticides; air, water, and noise pollution; solid waste disposal, and environmental laws.

87-112 EARTH AND SPACE SCIENCE II(3,0)3
A general survey course which will cover topics selected from the fields of astronomy, meteorology, and oceanography.

87-115 ASTRONOMY I I(3,0)3
An introduction to the field of astronomy. Topics include the historical development of astronomy, instruments used in astronomy, and the solar system.

87-116 ASTRONOMY II II(3,0)3
An introduction to the study of stars including stellar evolution, determination of the properties of stars, and structure of the Universe.

87-117 ASTRONOMY LAB I I(0,2)1
Corequisite: 87-115.

87-118 ASTRONOMY LAB II II(0,2)1
Corequisite: 87-116.

87-124 LAND USE PLANNING II(3,0)3
An introduction to the combined scientific concepts and skills required for effective management of land resources. Topics include: spatial patterns of land use development, geological, hydrological, ecological and climatological factors; demographic, economic and political aspects; and land ownership, survey and mapping systems.

87-232 ATMOSPHERIC SCIENCE II(3,0)3
A study of the origin and structure of the atmosphere, the physical principles governing atmospheric behavior, origin of weather patterns and climatic regimes, and the behavior and effects of atmospheric pollutants. Prerequisite: one year each of college physics and chemistry. Corequisite: 87-234.

87-234 ATMOSPHERIC SCIENCE LABORATORY II(0,2)1
Corequisite: 87-232.

87-401 SEMINAR IN REMOTE SENSING OF THE ENVIRONMENT I(3,0)3
 Selected topics in environmental science will be explored in depth through applications of high altitude aerial and satellite imagery. Analysis of the appropriate uses of various active and passive sensor systems will be followed by a project in which the student will utilize remotely sensed data to delineate the significance of environmental problems. Prerequisite: senior standing in Environmental Science.

87-455 AERIAL IMAGERY ANALYSIS II(3,0)3
 A study of the methods of obtaining scientific records of the environment from aerial platforms, and of the techniques of interpreting aerial photographic data to accurately detect physical and cultural landscape features for purposes of measuring, mapping, and monitoring specific environmental conditions and changes. Corequisite: 87-457.

87-457 AERIAL IMAGERY ANALYSIS LABORATORY II(0,2)1
 Corequisite: 87-455.

87-491 DIRECTED STUDY IN ENVIRONMENTAL SCIENCE I,II(ARR)1-3
 The student, through regular and frequent consultation with the instructor, will undertake independent study of a particular area of environmental science. Prerequisite: permission of instructor.

87-496 PRACTICUM EXPERIENCE I,II(ARR)1-3
 A program of campus and/or off-campus experiences developed by the student in consultation with an Earth Science's faculty member and, when appropriate, a member of the staff of an off-campus firm. May be repeated to a maximum of 6 credits. The practicum may not be substituted for a required course in the major. Prerequisite: permission of department chair.

Geography (Course Prefix: 88)

88-101 WORLD AND REGIONAL GEOGRAPHY I(3,0)3
 A survey of the significance, characteristics, and principal geographic problems of the world's major regions.

88-126 GEOGRAPHY OF THE UNITED STATES AND CANADA II(3,0)3
 A regional geography of North America, with emphasis on the human and physical characteristics of different geographic regions and their interaction with each other.

Geology (Course Prefix: 89)

89-101 GENERAL GEOLOGY I I(3,0)3
 A study of the Earth with emphasis on earth materials, earth structure (crustal and internal), earth history, and the development of life. Designed for the general student.

89-102 GENERAL GEOLOGY II II(3,0)3
 A study of the Earth with emphasis on the surface of the earth and landform development. Includes special topics introducing the student to recent geological research and applied geological knowledge. Designed for the general student.

89-103 GENERAL GEOLOGY LAB I I(0,2)1
 Corequisite: 89-101.

89-104 GENERAL GEOLOGY LAB II II(0,2)1
 Corequisite: 89-102.

89-121 PHYSICAL GEOLOGY I(3,0)3
 An introduction to the physical processes by which the earth undergoes change. Topics include tectonism, petrogenesis, and degradation through various surficial agents. This course should be of primary interest to the science student. Corequisite: 89-123.

89-123 PHYSICAL GEOLOGY LABORATORY I(0,3)1
 Corequisite: 89-121.

- 89-203 OCEANOGRAPHY** I(3,0)3
A survey of the geologic, chemical, physical, and biological aspects of the oceans. Topics include a study of the topography, structure, and origin of ocean basins and their margins; marine sedimentation; chemistry and circulation of ocean water; and biological environments. Prerequisite: one year each of college physics and chemistry. Corequisite: 89-205.
- 89-205 OCEANOGRAPHY LABORATORY** I(0,3)1
Corequisite: 89-203.
- 89-208 PALEONTOLOGY** I(3,0)3
Nature and origin of fossils: their biology, morphology, paleo-ecology, taxonomy, and evolutionary history. Special emphasis on the role of fossils in geologic chronology and correlation. Prerequisite: 89-121.
- 89-210 PALEONTOLOGY LABORATORY** I(0,2)1
Corequisite: 89-208.
- 89-213 ENVIRONMENTAL GEOLOGY** I(3,0)3
A study of how the abundance, occurrence and distribution of natural resources, and general geologic conditions, limit the activities of man. Topics include: the energy gap, natural resource limits on food production and industrial expansion, pollution accompanying resource utilization, urban geology and geologic hazards in land development.
- 89-251 MINERALOGY** I(3,0)3
An introduction to mineral identification and mineral structure with emphasis on laboratory determination. The course will examine the physical, chemical, and crystallographic properties of minerals. Prerequisite: one semester of chemistry. Corequisite: 89-253.
- 89-253 MINERALOGY LABORATORY** I(0,2)1
Corequisite: 89-251.
- 89-301 OPTICAL MINERALOGY** II(3,0)3
A systematic treatment of the optical properties of minerals. Use is made of crystallographic theory and optical-indicatrix representations to identify minerals with the polarizing microscope and X-ray diffractometer. Laboratory emphasizes oil immersion techniques and thin section identification, with an introduction to spindle stage methods. Prerequisite: 89-251. Corequisite: 89-303.
- 89-303 OPTICAL MINERALOGY LABORATORY** II(0,2)1
Corequisite: 89-301.
- 89-304 IGNEOUS AND METAMORPHIC PETROLOGY** I(3,0)3
Composition, classification, and origin of igneous and metamorphic rocks. Emphasis will be on thin section identification and use of rock textures and compositions as guides to petrogenesis. Prerequisite: 89-301.
- 89-306 IGNEOUS AND METAMORPHIC PETROLOGY LABORATORY** I(0,3)1
Corequisite: 89-304.
- 89-314 HYDROGEOLOGY** II(3,0)3
A study of the distribution and movement of water on the earth's surface with emphasis on the geologic effects. Topics include: application of statistics to streams, ground-water flow nets, well hydraulics. Prerequisite: Introduction to Calculus.
- 89-316 GEOMORPHOLOGY** II(3,0)3
A study of the physical and chemical processes at work on the earth's surface which result in the formation and development of surface features. Emphasis is placed on the mechanics of erosion (water, wind, ice, and waves) and the morphology and spatial distribution of the resultant landforms. Prerequisite: 89-121. Corequisite: 89-318.
- 89-318 GEOMORPHOLOGY LABORATORY** II(0,2)1
Corequisite: 89-316.
- 89-322 STRUCTURAL GEOLOGY** I(3,0)3
An analysis of crustal deformation through detailed study of geologic structures with emphasis upon the response

of geologic materials to stress. Field techniques, tectonic principles, and three-dimensional graphic analysis are employed. Prerequisite: one semester of physics: Corequisite: 89-324.

89-324 STRUCTURAL GEOLOGY LABORATORY I(0,2)1
Corequisite: 89-322.

89-326 GLACIAL AND PLEISTOCENE GEOLOGY II(3,0)3
A survey and interpretation of the erosional and depositional effects of glaciation with emphasis on the New England area. Topics include glaciology, glacial geology, and Pleistocene stratigraphy. Prerequisite: 89-316.

89-352 SEDIMENTATION AND STRATIGRAPHY II(3,0)3
Principles and processes of sedimentation and the resulting stratigraphic and structural units. Laboratory work includes stratigraphic cross-sections, identification and description of sedimentary rocks, and structures and determination of mass properties of sediments with emphasis on mechanical and statistical analysis. Prerequisite: 89-121. Corequisite: 89-354.

89-354 SEDIMENTATION AND STRATIGRAPHY LABORATORY II(0,2)1
Corequisite: 89-352.

89-431 REGIONAL GEOLOGY II(3,0)3
A survey of the stratigraphy, geologic structure, and physiography of various areas of the world with emphasis on North America. Discussions on the origin of various geologic provinces and the development of a model for global tectonics. Prerequisites: 89-322, 89-208, 89-352.

89-452 GEOCHEMISTRY II(3,0)3
Application of chemical principles to geologic problems. Topics include crystal chemistry, phase equilibria, stable isotopes and age dating, oxidation-reduction and pH of natural environments, abundance and distribution of elements in the earth, origin and evolution of igneous, metamorphic, and sedimentary rocks. Prerequisite: one year of college chemistry.

89-454 ECONOMIC GEOLOGY II(3,0)3
A study of the processes which lead to the formation of nonmetallic and metallic mineral deposits. Topics will include the origin of fossil fuels, sedimentary ore deposits, and ore deposits formed by igneous and metamorphic processes. Prerequisite: 89-304, 89-352.

89-491 DIRECTED STUDY IN GEOLOGY I,II(ARR)1-3
The student, through regular and frequent consultation with the instructor, will undertake independent study of a particular area of geology. Prerequisite: permission of instructor.

89-495 HONORS RESEARCH IN GEOLOGY I,II(ARR)3-6
An independent scientific research project carried out by a qualified senior under the supervision of a faculty member. May be taken by B.S. majors in lieu of 87-401. Prerequisite: consent of supervising faculty member.

Meteorology (Course Prefix: 93)

93-101 SEMINAR IN METEOROLOGY I(0,2)1
An introduction to the field of meteorology covering historical backgrounds, industrial applications, and areas of current research. Only for students majoring in meteorology.

93-142 INTRODUCTION TO WEATHER AND CLIMATE II(3,0)3
A nonmathematical survey of the atmospheric conditions that constitute weather and climate. Topics include: origin of the atmosphere; vertical variations of temperature, pressure and composition; effects of solar radiation on surface and atmospheric temperatures; the causes of air motions, clouds, rain, snow, thunderstorms; tornadoes and hurricanes; methods for forecasting weather; causes of climate changes; climatic regions and their classification. Designed for the general student.

93-211 ELEMENTARY METEOROLOGY I I(3,0)3
Synoptic and mean spatial variations of pressure, temperature, and velocity. Cyclones, anticyclones, fronts, waves, and jet streams. Elements of atmospheric thermodynamics and hydrodynamics; the equation of state; first law of thermodynamics, hypsometric equation, stability of hydrostatic equilibrium, thermal circulation, geostrophic and gradient motion, thermal wind. Prerequisite: 92-111 and 95-144.

- 93-212 **ELEMENTARY METEOROLOGY II** II(3,0)3
Atmospheric and solar radiation. Atmospheric heat budget. Distribution and causes of fog, clouds, precipitation, thunderstorms and tornadoes. Elements of general circulation theory and tropical meteorology. Prerequisite: 93-211.
- 93-301 **ATMOSPHERIC DYNAMICS I** I(3,0)3
Thermodynamics of dry air, water vapor and moist air. Hydrostatic equilibrium and its stability. Convection theory. The equations governing large-scale frictionless motion in the atmosphere. Steady state motion. Prerequisite: 93-211.
- 93-302 **ATMOSPHERIC DYNAMICS II** II(3,0)3
Development of thermal circulations: barotropic and baroclinic conditions, circulation, vorticity and divergence; mechanism of pressure change; Sutcliffe development and elements of numerical weather prediction. Prerequisite: 93-301.
- 93-308 **SYNOPTIC METEOROLOGY** I(2,3)3
An introduction to weather analysis: coding and plotting of data and elementary methods of analysis. Interpretation of current maps sent on the National Weather Facsimile Network. Prerequisite: 93-211.
- 93-313 **PHYSICAL CLIMATOLOGY** II(3,0)3
Atmospheric processes determining the climate; solar and terrestrial radiation, elevation and thermal properties of surfaces, atmospheric circulations and eddy conduction between the atmosphere and land or sea surfaces, heat and water balance of earth's surface and the atmosphere, hydrological cycle. Prerequisite: 93-212 or permission of instructor.
- 93-403 **PHYSICAL METEOROLOGY** I(3,0)3
Solar and terrestrial radiation processes and the heat balance of the atmosphere: fundamentals of radiation theory; radiative transfer processes in the atmosphere. Atmospheric condensation processes; nucleation theory and the growth of water drops and ice crystals by condensation, sublimation and accretion. Prerequisite: 93-301.
- 93-415 **ADVANCED ATMOSPHERIC DYNAMICS I** I(3,0)3
Dynamics of rotating fluids, atmospheric discontinuities, perturbation theory of wave motions. Stability of atmospheric circulation. Prerequisite: 93-301.
- 93-416 **ADVANCED ATMOSPHERIC DYNAMICS II** II(3,0)3
Atmospheric energy transformations. Atmospheric boundary layer processes. General circulation theory. Convection. Prerequisite: 93-302.
- 93-421 **ANALYSIS AND FORECASTING I** I(1,6)3
Analysis of recent synoptic data. Study of prediction techniques including the concepts of advection, thickness change, geostrophic vorticity change and vertical motion. Sutcliffe development in analysis and forecasting. Barotropic and primitive equation models in forecasting. Prerequisite: 93-415.
- 93-422 **ANALYSIS AND FORECASTING II** II(1,6)3
Graphical integration. Numerical methods and numerical weather prediction models. Practice in forecasting temperature, precipitation, wind speed and direction, fog, smoke, turbulence and icing using climatology, kinematics and dynamics. Use of verification procedures. Prerequisite: 93-421.
- 93-430 **ATMOSPHERIC DIFFUSION** II(3,0)3
Study of micrometeorology and the meteorological processes that affect the diffusion and removal of the atmospheric pollutants. Theories of diffusion and their application to the calculation of concentrations. The effects of obstacles and topography on atmospheric diffusion and transport. Meteorological factors involved in the design and location of stacks. Prerequisite: 92-302.
- 93-491 **DIRECTED STUDY IN METEOROLOGY** I,II(ARR)1-3
The student, through regular and frequent consultation with the instructor, will undertake independent study of a particular area of meteorology. Prerequisite: permission of instructor.
- 93-495 **RESEARCH PROJECT** I,II(ARR)3-6
An individual or team research project carried out by qualified students with the approval of, and supervision by, a faculty member. Prerequisite: consent of supervising faculty member.

93-496 PRACTICUM EXPERIENCE

I,II(ARR)1-3

A program of campus and/or off-campus experiences developed by the student in consultation with a Meteorology faculty member and, when appropriate, a member of the staff of an off-campus firm. May be repeated to a maximum of 6 credits. The practicum may not be substituted for a non-elective course in the major. Prerequisite: permission of the department chair.

DEPARTMENT OF MATHEMATICAL SCIENCES

Alan Doerr, Chairperson

Professors: Stephen Bodor, Robert Devejian, M. Brendan Fleming, Raoul Freyre, Thomas McElligott, Joseph Neuringer, Andrew Ouellette, Gerard Paquette, Giampiero Pecelli, Bernard Shapiro, Virginia Taylor, I. Jacob Weinberg

Associate Professors: Donald Ameen, Leonard Andrusaitis, Pasquale Condo, Walter Copley, Alan Doerr, Enrique Gonzalez-Velasco, Michael Grossman, Gerald Kaiser, Guntram Mueller, Alexander Olsen, Shelley L. Rasmussen, Garfield Schmidt, Marvin Stick, Arthur Talkington.

Assistant Professors: Indu Anand, Edward Baldyga, Patrick Cantwell, Angelo Dadoly, Theodore Faticoni, Ann Marie Hurley, Alan Kaplan, Thomas Kudzma, Kenneth Levasseur, Steven Pennell, Mary Beth Ruskai, Stanley Spiegel, Joyce Williams, Richard Winslow.

The Department of Mathematics offers a major in mathematics which leads to the Bachelor of Science degree. The Department also offers a minor area of study.

Mathematics Major

The major in mathematics is designed to provide a sequence of courses which will acquaint the student with the important concepts underlying the main branches of mathematics. The mathematics major is offered under requirements of the College of Pure and Applied Sciences for the Bachelor of Science degree and requires, at a minimum, 74 credits and 20 courses from the offerings of the College. The mathematics major curriculum exceeds the minimum recommendations of the Committee on Undergraduate Programs in Mathematics of the Mathematical Association of America for college mathematics programs. It provides a valuable background for subsequent graduate study in mathematics, in mathematics related disciplines, and in education, and for employment in business and industry. Mathematics majors are required to select one of the following areas of emphasis: applied mathematics and statistics, computer programming, pure mathematics.

Cooperative Education Program

The Department of Mathematics has formally adopted the voluntary University Cooperative Education Work Experience Program. This Program provides learning experiences for mathematics majors in their chosen careers, helps them to define their career goals, and can assist them in meeting their educational expenses. Students who are interested in this program should consult the Chairperson of the Department.

Honors in Mathematics

Selected mathematics students may qualify for honors in the major field. University requirements for major field honors are described elsewhere in this publication under the heading "Academic Policies: Academic Honors." The purpose of the honors program in mathematics is to give the conscientious and industrious student the special attention and recognition which his or her superior interest and performance in mathematics warrant. Students who currently are registered for, or who have completed, 92-222 may petition for admission to the honors program. Interested students should consult with the Chairperson of the Department.

Mathematics Minors

General Minor

A minor in mathematics consists of 18-24 credits chosen from the mathematics major core and option lists. At least 9 of such credits must be in mathematics courses not required by the student's major department. A minimum of 6 credits must be chosen from course offerings which are on or above the 300 course level.

Computer Programming

A minor in Computer Programming consists of 21 semester hours as specified below:

Requirements:

- One 200 level calculus course
- One FORTRAN course
- 92-265 Introduction to Pascal
- 92-367 Assembly Language

Three computer courses on or above the 300 course level from an approved list maintained in the Mathematical Sciences department office. Programming minor not available to students majoring in mathematics or computer science.

FIVE YEAR B.S./M.S. PROGRAM IN MATHEMATICS

- A. Applied Mathematics Option
- B. Computer Programming Option
- C. Statistics Option

General Description: The five year B.S./M.S. program consists of 122 hours of undergraduate credit and 30 hours of graduate credit. The 122 hours of undergraduate credit must satisfy all the requirements for an undergraduate degree in mathematics and the 30 hours of graduate credit must satisfy all the requirements for a Master of Science degree in chosen option.

One advantage of a combined 5 year B.S./M.S. program is that it allows advanced placement students, and/or those who can finish a number of the general electives of the undergraduate curriculum during the summer an opportunity to obtain an M.S. degree with only one additional year of work past the undergraduate degree.

A second advantage is that by starting to select graduate courses as early as the junior year and spreading the 30 hours of graduate credit over a three year period one usually has a much wider selection of graduate courses to choose from. Many graduate courses are not offered on a yearly basis and some courses have prerequisites so that even if one had the ability to complete 30 hours of course work in one year it is unlikely that there would be enough courses available during any one year to do so.

Eligibility: Any student who has completed three semesters of the undergraduate mathematics program with a grade point average overall and also in mathematics of 3.0 or better is eligible for the program. Advanced placement students may apply earlier.

Application Procedure: Make an appointment with the program coordinator to discuss your background and interests. If you wish to apply for admission to the program you may do so by sending a letter of application to the Graduate Coordinator, Mathematics Department, University of Lowell. A committee of the graduate faculty will review your record and notify you of their decision.

During the second semester of Junior year and upon approval and recommendation by the Department Graduate Selection Committee, the student will file formal application to the Graduate School. The student need not have taken the GRE examination. The committee decision will be based on: (a) overall grade point average, (b) grade point average in selected subjects, (c) recommendations by Department faculty, and (d) a 1-year minimum residency at the University of Lowell. Upon approval and recommendation by the Dean of the Graduate School the student may officially become a Provisional Graduate Student in the second semester of the Senior year.

Program Planning: Due to the flexibility inherent in this program, it is impossible to define a typical program. Generally one should begin taking graduate courses in the junior year and, in particular, plan to register for 92-501 and 92-511 at that time.

Consult the graduate catalogue or the brochures describing the options concerning the requirement for an M.S. in mathematics.

Two 400 level courses (6 credit hours) may be counted towards the 30 hours of graduate credit required, but not the same 400 level courses you count toward your undergraduate degree. You need to have a petition signed by the graduate coordinator before taking these 400 level courses, in order for them to count for graduate credit.

Summary of Degree Requirements

I University Core Requirements	23
Physical Education	2
English Composition	6
Area I (Behavioral & Social Sciences)	6-9*
Area II (Fine Arts & Humanities)	6-9*
Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified science courses of the Major Field Requirements for Supporting Sciences.

II Major Field Requirements	75
Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for a baccalaureate degree in mathematics. All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the College of Pure and Applied Sciences.	

A. Mathematics	59
1. Required Courses	41
92-133 Calculus A-I	4
92-134 Calculus A-II	4
92-221 Linear Algebra I	3
92-222 Linear Algebra II	3
92-233 Calculus A-III	3
92-234 Differential Equations	3
92-265 Introduction to Pascal	3
92-305 Introduction to Real Analysis I	3
92-306 Introduction to Real Analysis II	3
92-307 Probability and Mathematical Statistics I	3
92-308 Probability and Mathematical Statistics II	3
92-411 Complex Variables I	3
92-421 Abstract Algebra I	3
	18

2. Option Requirements and Electives	18
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Elective requirement

A total of six mathematics electives must be chosen. Three of these must be at the 400 or 500 course level. An additional two must be at the 300 course level or above. Academically qualified seniors should select 500 level courses.

Option requirement

Four of the above electives including at least two at the 400 or 500 course level must be from the option list for the chosen area of emphasis.

Option Lists

- Applied Mathematics and Statistics: 92-301, 92-302, 92-362, 92-401, 92-402, 92-409, 92-412, 92-413, 92-418, 92-452, 92-481, 92-482, 92-483, 92-484, 92-537, 92-538, 92-543, 92-544, 92-545, 92-546, 92-547, 92-551, 92-561, 92-563, 92-564, 92-571, 92-572, 92-582, 92-584, 92-587, 92-588.
- Computer Science: 92-360, 92-362, 92-363, 92-365, 92-366, 92-367, 92-422, 92-454, 92-459, 92-461, 92-462, 92-463, 92-464, 92-465, 92-466, 92-467, 92-469, 92-470, 92-471, 92-473.
- Pure Mathematics: 92-334, 92-371, 92-412, 92-422, 92-431, 92-432, 92-443, 92-447, 92-501, 92-502, 92-511, 92-512, 92-521, 92-531.

B Supporting Sciences	16
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A minimum of two one-year science courses with laboratory is required. Twelve of the sixteen required credits are applied to the Area III requirement. Suggested courses are as follows:

- Biological Sciences: 81-111, 81-112, 81-113, 81-114 (8)
- Chemistry: 84-121, 84-122, 84-123, 84-124 (8)
- Geology: 89-121 & 89-123 plus 89-316 & 89-318, or 89-251 & 89-253, or 89-208 & 89-210, or 89-203 & 89-205, or 87-232 & 87-234
- Life Sciences: 83-101, 83-102, 83-103, 83-104 (8)
- Physics: 95-141, 95-144, 96-141, 96-144, or 95-201, 95-202, 96-201, 96-202 (8)
- Radiological Sciences: 98-401, 98-402, 98-403 (8)

III Related Programs and Electives	24
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A Minor Programs

Four additional semester sequences may be elected (a minimum of 14 credits) to complete requirements for a minor in either of the sciences which have been taken to satisfy the above requirements. At least 6 credits at the 300 course level or above must be taken to fulfill minor requirements. (14-20)

Minor programs in other areas are possible if approved in advance. Students who are interested in such programs should file an academic petition with the Department Chairperson. (18-24)

B Elective Courses

The student must select courses totaling 24 credits from outside the mathematics department. These courses include those chosen for a minor, if any, but are in addition to those needed to satisfy area requirements and the supporting sciences requirement of the major field requirements. (0-24)

IV Minimum Credit Requirement	122
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SAMPLE COURSE OF STUDY FOR MATHEMATICS (Bachelor of Science Degree)#

Freshman Year

Fall Semester

92-133	Calculus A-I	4
42-101	College Writing	3
	Lab Science	4
92-265	Intro to Pascal	3
39-	Physical Education	1
		15

Spring Semester

92-134	Calculus A-II	4
42-102	College Writing & Literature	3
	Lab Science	4
	Elective (Non-Math)	3
39-	Physical Education	1
		15

Sophomore Year

Fall Semester

92-233	Calculus A-III	3
92-221	Linear Algebra I	3
	Lab Science	4
	Elective (Non-Math)	3
	Elective (Area I)	3
		16

Spring Semester

92-234	Differential Equations	3
92-222	Linear Algebra II	3
	Lab Science	4
	Elective (Non-Math)	3
	Elective (Area I)	3
		16

Junior Year

Fall Semester

92-305	Intro to Real Analysis	3
*92-307	Probability & Mathematical Statistics I	3
#92-	Math Option 300 or above	3
	Elective (Non-Math)	3
	Elective (Area II)	3
		15

Spring Semester

92-306	Intro to Real Analysis II	3
*92-308	Probability & Mathematical Statistics II	3
#92-	Math Option 300 or above	3
	Elective (Non-Math)	3
	Elective (Area II)	3
		15

Senior Year

Fall Semester

92-411	Complex Variables I	3
92-421	Abstract Algebra I	3
92-	Math Option 400 or above	3
	Elective (Non-Math)	3
	Elective (Area I or II)	3
		15

Spring Semester

92-	Math Option 400 or above	3
#92-	Math Elective 300 or above	3
92-	Math Elective	3
	Elective (Non-Math)	3
	Elective (Non-Math)	3
		15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Students who elect the pure mathematics option may substitute other approved mathematics courses for 92-307 and 92-308.

#At least one of these courses must be at the 400 or 500 course level.

SAMPLE COURSE OF STUDY FOR MATHEMATICS - COMPUTER PROGRAMMING OPTION

(Bachelor of Science Degree)

Freshman Year

Fall Semester

92-133	Calculus A-I	4
42-101	College Writing	3
	Lab Science	4
92-265	Intro to Pascal	3
39-	Physical Education	1
		15

Spring Semester

92-134	Calculus A-II	4
42-102	College Writing & Literature	3
	Lab Science	4
	Elective (Non-Math)	3
39-	Physical Education	1
		15

Sophomore Year

Fall Semester

92-233	Calculus A-III	3
92-221	Linear Algebra I	3
	Lab Science	4
92-367	Assembly Language Programming	3
	Elective (Area I)	3
		16

Spring Semester

92-234	Differential Equations	3
92-222	Linear Algebra II	3
	Lab Science	4
92-360	Intro to Data Structures	3
	Elective (Area I)	3
		16

Junior Year

Fall Semester

92-305	Intro to Real Analysis I	3
92-307	Probability & Mathematical Statistics I	3
92-411	Complex Analysis I	3
	Elective (Non-Math)	3
	Elective (Area II)	3
		15

Spring Semester

92-306	Intro to Real Analysis II	3
92-308	Probability & Mathematical Statistics II	3
92-362	Numerical Analysis I	3
	Elective (Non-Math)	3
	Elective (Area II)	3
		15

Senior Year					
Fall Semester			Spring Semester		
92-421	Abstract Algebra I	3	92-466	Theory of Computation	3
92-465	Formal Language Theory	3	92-	Math Elective 400 or above	3
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area I or II)	3		Elective (Non-Math)	3
		15			15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

SAMPLE COURSE OF STUDY FOR MATHEMATICS - STATISTICS & APPLIED MATHEMATICS OPTION# (Bachelor of Science Degree)

Freshman Year					
Fall Semester			Spring Semester		
92-133	Calculus A-I	4	92-134	Calculus A-II	4
42-101	College Writing	3	42-102	College Writing & Literature	3
	Lab Science	4		Lab Science	4
92-265	Intro to Pascal	3		Elective (Non-Math)	3
39-	Physical Education	1	39-	Physical Education	1
		15			15
Sophomore Year					
Fall Semester			Spring Semester		
92-233	Calculus A-III	3	92-234	Differential Equations	3
92-221	Linear Algebra I	3	92-222	Linear Algebra II	3
	Lab Science	4		Lab Science	4
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area I)	3		Elective (Area I)	3
		16			16
Junior Year					
Fall Semester			Spring Semester		
92-305	Intro to Real Analysis I	3	92-306	Intro to Real Analysis II	3
92-307	Probability & Mathematical Statistics I	3	92-308	Probability & Mathematical Statistics II	3
92-411	Complex Variables I	3	92-362	Numerical Analysis I	3
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area II)	3		Elective (Area II)	3
		15			15
Senior Year					
Fall Semester			Spring Semester		
92-421	Abstract Algebra I	3	*92-484	Design of Experiments	3
*92-483	Applied Statistical Methods	3	*92-413	Sampling Theory	3
*92-454	Numerical Analysis II	3	*92-452	Intermediate Mathematical Statistics	3
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area I or II)	3		Elective (Non-Math)	3
		15			15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*These courses may not be offered every year. Substitutions may be made from the applied mathematics and statistics option list.

SAMPLE COURSE OF STUDY FOR MATHEMATICS - PURE MATHEMATICS OPTION# (Bachelor of Science Degree)

Freshman Year					
Fall Semester		Spring Semester			
92-133	Calculus A-I	4	92-134	Calculus A-II	4
42-101	College Writing	3	42-102	College Writing & Literature	3
	Lab Science	4		Lab Science	4
92-265	Intro to Pascal	3		Elective (Non-Math)	3
39-	Physical Education	1	39-	Physical Education	1
		15			15
Sophomore Year					
Fall Semester		Spring Semester			
92-233	Calculus A-III	3	92-234	Differential Equations	3
92-221	Linear Algebra I	3	92-222	Linear Algebra II	3
	Lab Science	4		Lab Science	4
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area I)	3		Elective (Area I)	3
		16			16

Junior Year					
Fall Semester			Spring Semester		
92-305	Intro to Real Analysis I	3	92-306	Intro to Real Analysis II	3
92-307	Probability & Mathematical Statistics I	3	92-308	Probability & Mathematical Statistics II	3
92-411	Complex Variables I	3	92-412	Complex Variables II	3
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area II)	3		Elective (Area II)	3
		15			15
Senior Year					
Fall Semester			Spring Semester		
92-421	Abstract Algebra I	3	92-422	Abstract Algebra II	3
*92-431	Topology I	3	*92-432	Topology II	3
	Math Elective 300 or above	3		Mathematics Elective	3
	Elective (Non-Math)	3		Elective (Non-Math)	3
	Elective (Area I or II)	3		Elective (Non-Math)	3
		15			15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*These courses may not be offered every year. Substitutions may be made from the pure mathematics option list.

Mathematics (Course Prefix: 92)

92-103 WORLD OF MATHEMATICS I I(3,0)3
Review of basic mathematics, equations, ratio and proportion, wages and salaries, commissions, taxes, insurance: automobile, life, and health; computer programming in the BASIC language. (Credit given only to students with less than two years of high school algebra.)

92-104 WORLD OF MATHEMATICS II II(3,0)3
Simple and compound interest, annuities, sinking funds and amortization, installment buying, consumer loans, investing in stocks and bonds, discounts, inventory, financial statements, depreciation, statistics, probability, and the metric system. Prerequisite: 92-103 (Credit given only to students with less than two years of high school algebra.)

92-115 COLLEGE TRIGONOMETRY II(3,0)3
Angles and their measure, the trigonometric functions, solving triangles, law of sines, law of cosines, circular functions and their graphs, trigonometric identities.

92-121 PRE-CALCULUS MATHEMATICS I(2,2)3
Review of algebra: operations on the real numbers, exponential notation, factoring, radical notation, and rational exponents. Linear and fractional equations, inequalities, radical equations, and quadratic equations. Relations, functions, graphs, symmetry, straight lines, circles, parabolas, systems of equations, mathematical models, graphs of trigonometric functions.

92-122 DIFFERENTIAL CALCULUS II(2,2)3
Computer programming in BASIC on the University computer. Differential calculus: limits, continuity, derivatives, differentials, higher-order derivatives, implicit differentiation, maxima and minima of functions and applications of derivatives. Prerequisite: 92-121. Primarily for students in management science.

92-131 CALCULUS B-I I-II(4,0)4
Review of algebra and trigonometry, analytic geometry. Functions, derivatives, and curve sketching, with applications. Integration, area.

92-132 CALCULUS B-II II(4,0)4
Applications of the definite integral. Trigonometric, exponential, logarithmic, and hyperbolic functions. Techniques of integration. Infinite series. Prerequisite: 92-131.

92-133 CALCULUS A-I I(4,0)4
Functions, derivatives, and curve sketching, with applications. Riemann integration, area, and applications of the definite integral.

92-134 CALCULUS A-II II(4,0)4
Trigonometric, exponential, logarithmic, and hyperbolic functions. Techniques of integration. Infinite series. Polar coordinates, vectors. Prerequisite: 92-133 with a grade of C or better.

- 92-135, 136, and 235 INDIVIDUALIZED CALCULUS I, II, III I, II(4,0)4, (4,0)4, (3,0)3
Coverage similar to that of 92-133, 134, and 233. Course is pivoted on formulation of problems mathematically and the understanding and appreciation of how approximations are used. The individualized format permits students to accelerate and finish the three semester sequence in less time. Prerequisite: permission of instructor.
- 92-201 INTEGRAL CALCULUS I(3,0)3
Exponential and logarithmic functions, area under a curve, fundamental theorem of calculus, integration by parts, areas between curves, applications of integration to business and economics, differential equations, multivariable calculus, maxima and minima using Lagrange multipliers. Matrix algebra: matrix operations, inverse of a matrix, solving simultaneous equations with matrices. Prerequisite: 92-132
- 92-203 MATHEMATICS OF MUSIC I, II(3,0)3
A study of the relation and application of mathematics to music. Review of algebra and logarithms; application to the construction of musical scales (Pythagorean, tempered, mean-tone and just); loudness levels and decibels; review of trigonometry; application to the analysis and synthesis of musical sound from harmonics; elementary signal processing; hearing and the ear. Scientific calculators with trigonometric and logarithmic functions facilitate the understanding and application of many of the mathematical concepts, and are a required part of the course. Harmonic synthesis is demonstrated on a digital synthesizer coupled to an oscilloscope. Prerequisites: Algebra and Trigonometry.
- 92-207 MATHEMATICAL TECHNIQUES OF PHYSICS I I(4,0)4
Hyperbolic functions, polar coordinates, vectors and parametric equations, solid geometry and vectors, partial differentiation, multiple integrals. For physics majors only.
- 92-208 MATHEMATICAL TECHNIQUES OF PHYSICS II II(4,0)4
Infinite series, differential equations: first order, linear, and power series solutions. Vector differential calculus, vector fields. The integral theorems of Green, Gauss, and Stokes. For physics majors only. Prerequisite: 92-207.
- 92-209 INTRODUCTION TO BASIC I, II(3,0)3
An introduction to the processing of information by computer. Computer logic, memory, inputs and outputs, timesharing, flowcharting techniques, and programming in the BASIC language. Prerequisite: 92-121 or equivalent. (No credit for students who have 2 or more credits in a college-level programming course.)
- 92-216 HISTORY OF MATHEMATICS I(3,0)3
An investigation of creative mathematics through the lives of mathematicians from classical times to the present.
- 92-219 BASIC PROGRAMMING I(3,0)3
Programming in BASIC including nested loop, subscripted variables, string manipulation, subroutines, and advanced programming techniques. Prerequisite: Working knowledge of some other programming language.
- 92-221 LINEAR ALGEBRA I I(3,0)3
Elementary set theory and solution sets of systems of linear equations. An introduction to proofs and the axiomatic methods through a study of the vectorspace axioms. Linear analytic geometry. Linear dependence and independence, subspaces, basis. Inner products. Matrix algebra.
- 92-222 LINEAR ALGEBRA II II(3,0)3
Linear transformations. Linear operators, change of basis, and the diagonalization problem. Quadratic forms. Convex sets and geometric programming, input output models for an economy, Markov chains, or other applications of linear algebra. Prerequisites 92-221 and 92-132/134.
- 92-231 CALCULUS B-III I(4,0)4
Polar coordinates, vectors, solid analytic geometry, partial derivatives, multiple integrals. Prerequisite 92-132.
- 92-233 CALCULUS A-III I(3,0)3
Solid analytic geometry, partial derivatives, multiple integrals. Prerequisite: 92-134 with a grade of C or better.
- 92-234 DIFFERENTIAL EQUATIONS II(3,0)3
The classification and solution of ordinary differential equations of the first order and higher orders. The Laplace Transform. Applications. Prerequisite: 92-132/134.
- 92-236 INDIVIDUALIZED DIFFERENTIAL EQUATIONS II(3,0)3
First and second order differential equations with applications. Series solutions of ordinary differential equations. The LaPlace transform. Prerequisite: 92-134/136.

- 92-242 BASIC PROGRAMMING WITH BUSINESS APPLICATIONS II(3,0)3
Advanced programming utilizing the BASIC language but accenting the use of canned programs on both the CYBER 170 and microcomputers. Topics will include advanced programming, business data processing, files, arrays, number crunching, simulation, and SPSS. Prerequisite: Prior programming experience.
- 92-261 INTRODUCTION TO FORTRAN I, II(2,0)2
Programming principles of FORTRAN including input-output, arithmetic and control statements, arrays, functions, and subroutines. (Credit given for no more than one of the courses 92-261, and 92-263 or equivalent.)
- 92-263 FORTRAN PROGRAMMING I, II(3,0)3
Programming principles of FORTRAN including input-output, arithmetic and control statements, arrays, functions, and subroutines. Structured programming will be emphasized. Students will process several programs on the University computer. (Credit given for no more than one of the courses 92-261, and 92-263 or equivalent.)
- 92-265 INTRODUCTION TO PASCAL I(3,0)3
An introduction to computer programming including the elements of algorithm design and data structures. The PASCAL language will be used. Topics covered include: algorithm development by step-wise refinement, language control structures, functions and procedures, the standard data types, scalar data types, and an introduction to structured types. The student will process a number of programs on the University computer.
- 92-266 CONCEPTS OF COMPUTING (Formerly 92-264) I(3,0)3
Types of computers and their operations. Characteristics, storage, and calculation principles. Addressing schemes. Computer arithmetic and logic, numbering systems, instruction codes, input-output organization and devices, organizing computer files and data communications. Prerequisite: 92-265
- 92-301 INTRODUCTION TO APPLIED MATHEMATICS I I(3,0)3
Matrices, Vector analysis, review of vector calculus, divergence theorem. Green's theorem and Stokes' theorem. Prerequisite: 92-231 or 92-233.
- 92-302 INTRODUCTION TO APPLIED MATHEMATICS II II(3,0)3
Series solutions of ordinary differential equations. Bessel functions, Legendre functions. Ordinary differential equations, boundary value problems. Fourier series and integrals. Partial differential equations of physics and engineering, separation of variables. Prerequisite: 92-234.
- 92-305 INTRODUCTION TO REAL ANALYSIS I I(3,0)3
Some set theory including equivalence and countability. An axiomatic introduction to the real number system. Sequences of real numbers including boundedness, monotonicity, convergence, divergence. Series of real numbers including convergence, divergence, absolute convergence. Limits and continuity of real functions of a real variable. Metric spaces including open sets, closed sets, limits of sequences, limits and continuity of functions, connected sets, compact sets, bounded sets, totally bounded sets, completeness, continuous functions on compact sets, the Intermediate Value Theorem, uniform continuity. Prerequisites: 92-221 and 92-132/134.
- 92-306 INTRODUCTION TO REAL ANALYSIS II II(3,0)3
The calculus of Newton & Leibnitz including the Riemann integral, averages of a function, the derivative, the Fundamental Theorems of Calculus, the Mean Value Theorem. Sequences and series of real valued functions of a real variable including pointwise convergence, uniform convergence, integration and differentiation. The Weierstrass Approximation Theorem and the Stone-Weierstrass Theorem, Lebesgue measure including measurable sets, nonmeasurable sets, measurable functions. The Lebesgue integral including the Lebesgue Dominated Convergence Theorem, Fatou's Lemma, and the metric space $L^2[a,b]$. Prerequisite: 92-305.
- 92-307 PROBABILITY AND MATHEMATICAL STATISTICS I I(3,0)3
Probability functions and densities, expectations. Moments of probability distributions. Central limit theorem. Prerequisite 92-231/233.
- 92-308 PROBABILITY AND MATHEMATICAL STATISTICS II II(3,0)3
Sampling, decision theory, estimation, hypothesis testing, regression and correlation. Prerequisite 92-307.
- 92-310 MATHEMATICAL TECHNIQUES OF PHYSICS III(Formerly 95-308) I(4,0)4
Complex numbers, elementary functions, analytic functions, line integrals, Cauchy's formulas, residue theorem; partial differential equations of physics; separation of variables, eigenvalue problems, Fourier series, Fourier transforms. Prerequisite: 92-208.

- 92-311 MATRIX THEORY AND APPLICATIONS** II(3,0)3
Algebra of vectors, matrices and determinants. Characteristic values, characteristic vectors, and diagonal forms. Calculus of matrices, matrix polynomials. Applications to differential and difference equations. Prerequisite: 92-234. (Not for mathematics majors or students who have taken 92-222.)
- 92-317 APPLIED MATHEMATICS FOR CHEMICAL ENGINEERS** I(3,0)3
Brief review of ordinary differential equations and vector calculus, intensive coverage of LaPlace transforms, series solutions of differential equations (including Method of Frobenius, Fourier series, and Bessel's equation), methods of solving partial differential equations, applications of finite difference and numerical methods. Emphasis on applications in chemical engineering. Prerequisite: 92-234. Chemical Engineering majors only.
- 92-321 DISCRETE STRUCTURES I** I(3,0)3
Propositional logic, connectives, rules of inference, quantifiers. Proofs, proof of contradiction, induction, applications in computer logic and proofs of program correctness. Algebra of sets, relations on sets, equivalence relations, functions, composition, one-to-one, onto, orderings, applications to data structures and topological sorting. Matrices, solution sets for systems of matrix operations, eigenvalues and eigenvectors, diagonalization and Jordan canonical form.
- 92-322 DISCRETE STRUCTURES II**
Algebraic structures, sets with operations, associative, commutative, and distributive operations, modular arithmetic, electronic privacy and signature. Groups and semigroups, group axioms, permutation groups, cosets, normal subgroups, sequential machines. Directed and undirected graphs, paths, circuits, reachability and connectedness, decision trees, balanced trees, polish notation and trees, graph scheduling problems, flow in network, data structures. Lattices and Boolean algebra, switching theory, logic design. Finite fields, representation and structure, minimal and irreducible polynomials, primitive elements, polynomial roots, error-correcting codes, public security key systems. Prerequisite: 92-321.
- 92-334 MODERN GEOMETRY** I(3,0)3
Transforms in the Euclidean plane. Non-Euclidean geometry. Topics in hyperbolic geometry and projective geometry. Prerequisites: 92-231/233.
- 92-360 INTRODUCTION TO DATA STRUCTURES** II(3,0)3
Basic concepts of data. Linear lists, strings, arrays, and orthogonal lists. Trees and graphs. Storage systems and structures. Storage allocation and collection. Multilinked structures. Symbol tables, searching and sorting (ordering) techniques. Prerequisite: 92-221 and 92-265.
- 92-362 NUMERICAL ANALYSIS II** II(3,0)3
Theory and application of numerical techniques including error analysis, solution of linear, nonlinear, and differential equations, interpolation, numerical integration, and curve fitting. Computer solutions are emphasized. Prerequisite: 92-231/233 and knowledge of one computer language.
- 92-363 INTRODUCTION TO DATA ANALYSIS** II(3,0)3
Computer analysis of data derived from research conducted in physical, social and life sciences. Data preparation. SPSS system, data modification, file manipulation, descriptive and complex multivariate statistics. Programming ability is not required. Prerequisite: 92-383 or equivalent.
- 92-365 COBOL PROGRAMMING I** I(3,0)3
Programming principles of COBOL (the Common Business Oriented Language), identification, environment, data, and procedures divisions, introduction to compilation procedures. Students will process several problems in the University's computer.
- 92-366 ADVANCED FORTRAN PROGRAMMING** II(3,0)3
Advanced FORTRAN programming techniques including multidimensional arrays, all Fortran data types, character data, file manipulations, and advanced subprogram techniques. An in-depth treatment of such fundamental concepts as data storage, subprogram argument passing, and multidimensional array addressing. Additional topics include testing and debugging, numerical accuracy, use of library subroutines, documentation, the interaction of FORTRAN with the operating system, and implementation of algorithms. Prerequisite: 92-263 or 92-261 and permission of instructor.
- 92-367 ASSEMBLER LANGUAGE PROGRAMMING** I(3,0)3
Absolute machine language coding and the symbolic programming language, the coding of practice problems on

a high-speed digital computer using the basic computer instructions including arithmetic, input-output, logic control operations and data manipulation. Prerequisite: 92-261/263 or 92-265 or permission of instructor.

92-368 COBOL PROGRAMMING II I(3,0)3
A continuation of 92-365, this hands-on course requires the student to generate a number of COBOL programs, utilizing the advanced components of the COBOL language. Topics begin with multidimensional tables and include a complete examination of COBOL I/O procedures with random and sequential files, the implementation of the SORT/MERGE and REPORT WRITER modules, and the use of the intercommunication facility for the support of subroutines written in COBOL, FORTRAN and assembly language. Prerequisite: 92-365.

92-371 NUMBER THEORY II(3,0)3
Congruences and residue classes, quadratic residues. Diophantine equations, number theoretic functions, distribution of primes. Prerequisite: 92-221.

92-381 INTRODUCTION TO OPERATIONS RESEARCH TECHNIQUES I I(3,0)3
The use of decision models in industrial systems. Fundamentals of probability and matrix theory. Critical path methods. Linear programming. The simplex method. Sensitivity analysis. Goal programming. Transportation and assignment models. Integer programming. Prerequisite 92-132 or 92-134 or 92-102.

92-382 INTRODUCTION TO OPERATIONS RESEARCH TECHNIQUES II II(3,0)3
A continuation of 92-381. Topics include: inventory control models, Markov analysis, queueing models, dynamic programming, network analysis, and simulation techniques. Prerequisite: 92-381.

92-383 INTRODUCTION TO STATISTICS I, II(3,0)3
Sets and probability laws, random variables, mathematical expectations, measure of central tendency and variance. Study of discrete and continuous probability distribution, sampling theory, tests of hypothesis. Regression and correlation. (Primarily for students who want a one-semester introduction to statistics. Students who want a more detailed development of statistics and probability are advised to take the sequence 92-387, 92-388. Introduction to Statistics may not be used to satisfy mathematics major requirements.)

92-385 BIOSTATISTICS II(3,0)3
Probability distributions, measure of central tendency and variance, principles of statistical inference, analysis of variance employing nested and block designs, factorial experiments, multi-range comparison tests, analysis of covariance, correlation and regression, nonparametric statistics. The course will include computer methods for solution of problems. (For biological science majors only.)

92-386 STATISTICS FOR ENGINEERING AND SCIENCE II(3,0)3
A one semester course in probability and statistics with applications in the engineering sciences. Probability of events, discrete and continuous random variables, density functions, distributions. Estimation, hypothesis testing, regression and correlation. May not be taken for credit along with 92-383, 92-385, 92-387, or 92-388. Prerequisite: 92-132/134.

92-387 PROBABILITY I(3,0)3
Experiments and events, basic notions of probability, conditional probability, Bayes theorem. Random variables, discrete and continuous distributions, marginals and conditionals, examples of distributions including binomial, Poisson, normal, and exponential. Law of large numbers, central limit theorem. (May not be used to satisfy mathematics major requirements). Prerequisite: 92-132/134.

92-388 STATISTICS II(3,0)3
The completion of a two semester sequence in probability and statistics. Statistical techniques, including point estimation and confidence intervals, hypothesis testing, regression and correlation, goodness of fit, tests of independence. Prerequisite: 92-387.

92-401 APPLIED MATHEMATICS I I(3,0)3
Function spaces, Fourier series, quadratic and Hermetian forms, calculus of variations, Sturm-Liouville problems, series solution of ordinary differential equations, eigenfunction expansion and application to boundary value problems. Prerequisite: 92-221 and 92-411.

92-402 APPLIED MATHEMATICS II II(3,0)3
Green's functions and applications to boundary value problems, integral equations, integral transform methods applied to ordinary differential equations, partial differential equations, and integral equations. Prerequisite: 92-401.

- 92-409 DEMOGRAPHY** I(3,0)3
The study, the methods, and the materials used in the systematic compilation and analysis of population data. Primary focus is on learning sources of data, definitions collection techniques, population characteristics and dynamics, summarizing and analyzing data and methods of estimation and projecting. Prerequisite: 92-383 or equivalent.
- 92-411 COMPLEX VARIABLES I** II(3,0)3
Complex numbers. Functions of a complex variable. Mappings. Derivatives. Analytic functions. Elementary functions. Integrals. Laurent series. Residues and poles. Contour integration. Prerequisites: 92-231/233.
- 92-412 COMPLEX VARIABLES II** I(3,0)3
Transformations. Conformal mappings, Boundary conditions. Application in heat conduction, electrostatic potential, and fluid flow. Gamma and beta functions. Inverse Laplace transform. Riemann surfaces. Prerequisite: 92-411.
- 92-413 STATISTICAL SAMPLING** II(3,0)3
This course involves the students in actual surveys. The student and instructor draw up the questionnaires, choose the population, compile the data and analyze the results. Prerequisite: 92-383 or equivalent.
- 92-414 MATHEMATICAL METHODS IN ENGINEERING MANAGEMENT** II(3,0)3
The concepts of economic aspects of engineering. Judging the attractiveness of proposed investments using such methods as annual cost and present worth analysis along with utilization of other techniques suited to government, industry, tax and non-tax applicable studies.
- 92-416 COMPOUND INTEREST & ANNUITIES — CERTAIN** I(3,0)3
Basic concepts and definitions of various types of annuities, valuation of annuities — certain, valuation of securities and sinking funds, determination of yields, and construction of tables. prerequisite: 92-231/233.
- 92-418 MATHEMATICAL METHODS OF ENGINEERING ECONOMICS** II(3,0)3
Analytical presentation of microeconomic theory as a unified body of knowledge. Mathematical treatment throughout. Linear programming, game theory, probabilistic models, input-output analysis and Bayesian statistics used in problem solution. Prerequisite: 92-231/233.
- 92-421 ABSTRACT ALGEBRA I** I(3,0)3
Elementary group theory, groups, cosets, normal subgroups, quotient groups, isomorphisms, homomorphisms, series of groups, the Sylow theorems, free groups and homology groups. Prerequisite: 92-221.
- 92-422 ABSTRACT ALGEBRA II** II(3,0)3
Elementary ring and field theory, quotient rings and ideals, homomorphisms of rings, rings of polynomials, algebraic extensions, automorphisms of field, separable extensions. Galois Theory. Introduction to categories and functors. Prerequisite: 92-421.
- 92-431 TOPOLOGY I** I, II(3,0)3
Cardinality, partially ordered sets and Zorn's lemma, topology of the line and plane, topological spaces, continuity and topological equivalence. Prerequisite: 92-306.
- 92-432 TOPOLOGY II** II(3,0)3
Metric and normed spaces, compactness, connectedness, product spaces, function spaces, fundamental group. Prerequisite: 92-431.
- 92-442 BOUNDARY VALUE PROBLEMS** I(3,0)3
The Fourier series as a tool of analysis. Orthogonal functions, convergence tests, the Fourier integral, partial differential equations of physics and engineering, and boundary value problems. Prerequisite: 92-234.
- 92-443 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS** I(3,0)3
Theory of the existence and uniqueness of systems of ordinary differential equations. Examination of various stability theories of linear and nonlinear autonomous and unautonomous systems. Periodic systems and applications of perturbation and asymptotic methods to the solution of nonlinear systems encountered in the engineering and physical sciences. Prerequisite: 92-234.
- 92-445 OPERATIONAL CALCULUS** II(3,0)3
The Laplace transform, its properties and uses in translation of a time function, in convolution, in differentia-

tion and in integration. Applications in the analysis of vibrations, deflections, and electric circuits, problems in partial differential equations, and Fourier transforms. Prerequisite: 92-234.

92-447 VECTOR CALCULUS FOR SCIENCE AND ENGINEERING I, II(3,0)3

Cylindrical and spherical coordinate systems; curves and surfaces; differential forms; the exterior derivative as a generalization of the gradient, curl, and divergence; Stokes' Theorem and its various forms; a simple formulation of Maxwell's equations in terms of differential forms. Prerequisite: 92-231/233.

92-452 INTERMEDIATE MATHEMATICAL STATISTICS II(3,0)3

A survey of topics in mathematical statistics, including those covered in the second actuarial exam. Maximum likelihood estimation, sufficient statistics, completeness and uniqueness, likelihood ratio tests, UMP tests, Rao-Blackwell Theorem, non-central chi-squared and F distributions, SPRT, some multivariate distributions. Prerequisite: 92-307.

92-453 PASCAL PROGRAMMING I, II(3,0)3

This course will introduce a number of concepts and techniques of program design via the PASCAL language. In addition to the basics of Pascal (constants, variables, assignment statements, arithmetic expressions, input/output, basic and advanced data types, control structures, functions and procedures) the emphasis will be on program style and algorithm development. Topics to be covered include basic problem-solving techniques, flow-charting, stepwise refinement, recursive algorithms, dynamic information structures, and an introduction to proof-of-correctness or another advanced topic. (Credit will be given for only one of 92-265 and 92-453.)

92-454 NUMERICAL ANALYSIS II II(3,0)3

Continuation of 92-362 including: numerical solution of ordinary and partial differential equations, boundary value problems, curve-fitting, error analysis and computer solutions. Prerequisite: 92-362.

92-459 ARTIFICIAL INTELLIGENCE I(3,0)3

An introduction to the field of intelligent software. This includes a survey of the field in general, with a detailed evaluation of some of the specialized branches of the field which currently define the state of the art. The student will be exposed to the classical techniques of state-space representations, state-space search algorithms, problem-reduction representations, and problem-reduction search methods. The LISP programming language will be introduced as a natural language for the implementation of intelligent software, and the student will be required to code and execute a number of programs in LISP. Prerequisite: 92-263 or 92-265, and permission of instructor.

92-461 SYSTEMS SIMULATION AND MODELING I(3,0)3

Procedures in model construction and computerized simulation, modeling tools and techniques, model conceptualization and implementation, selected applications of simulation. Prerequisite: 92-261/263 or equivalent.

92-462 SYSTEMS PROGRAMMING II(3,0)3

Basic concepts of assembly programs and compilers, macro-generators, utility programs, supervisors, monitors and high level languages. Prerequisites: 92-367, 92-360.

92-463 SYSTEMS DESIGN AND DEVELOPMENT I I(3,0)3

A general study of the design and development of computer-oriented data processing systems including: the approach requirements of the system, developing the solution, data controls, system controls, system evaluation and reporting to management. Prerequisite: 92-367.

92-464 SYSTEMS DESIGN AND DEVELOPMENT II II(3,0)3

A continuation of 92-463 including: finalizing and implementing the system, post-installation evaluation, and interdepartmental coordination, case studies. Prerequisite: 92-265.

92-465 FORMAL LANGUAGES I(3,0)3

This course will study the formal or abstract properties of (computer) languages and of acceptors/recognizers for valid expressions in the syntax of the languages. Topics to be covered will include: the Chomsky hierarchy of languages, Finite State Machines: their basic properties/results and as acceptors for Regular Expressions. Two-way Acceptors and Automata, Pushdown Automata: acceptors for Context Free Languages and grammars for Pushdown Automata. Context Free Grammars. Transformations on grammars and canonical forms for grammars. Syntax Analysis: top-down, bottom-up and precedence analysis. Parsing. Turing Machines. Prerequisite: 92-265.

- 92-466 **THEORY OF COMPUTATION** II(3,0)3
Models of computation. Turing machines and Turing-computable functions. Other models of computation. The Church-Turing thesis. Universal machines. Recursive functions, primitive recursive and partial recursive functions. Simulation of various computations. Recursive and recursively enumerable sets. Unsolvable problems: Computable versus non-computable functions. Halting problem, equivalence problem, work problems, etc. Other topics as time and interest permit. Prerequisite: 92-265.
- 92-467 **ASSEMBLY LANGUAGE PROGRAMMING II** II(3,0)3
A continuation of 92-367. Symbolic programming using advanced techniques including macro instructions, indirect addressing, file generation and processing, magnetic tape and magnetic disk applications. Prerequisite: 92-367.
- 92-468 **MINICOMPUTER PRINCIPLES AND APPLICATIONS** II(3,0)3
Current minicomputer practices covering both hardware and software including basic minicomputer instruction sets, operating systems, assembler and I/O programming, utilities, interrupts, and interfaces. Scientific, industrial and business applications throughout. Prerequisite: 92-367.
- 92-469 **COMPILER CONSTRUCTION TECHNIQUES** I(3,0)3
Typical compiler organization is studied including symbol tables, various types of scans, object code generation, error diagnostics, and optimization techniques. Segments of a classroom compiler are written by students. Prerequisites: 92-367, 92-460.
- 92-470 **DATA COMMUNICATIONS** II(3,0)3
Analysis and use of remote computing systems including time-sharing, remote-batch, and real-time systems. Design characteristics, applications, data communications, economics and management of such systems. Prerequisite: 92-265 or 92-453, and 92-360.
- 92-471 **INTRODUCTION TO THE DESIGN AND ANALYSIS OF ALGORITHMS** I(3,0)3
Basic steps in developing an algorithm, correctness, algorithm design techniques such as hill climbing, subgoals, heuristics, backtracking, branch and bound, recursion, sorting and searching, paging, parallelism, algorithm and program correctness; measures of algorithm efficiency, complexity, and overall effectiveness. Prerequisite: permission of instructor.
- 92-473 **HIGHER LEVEL LANGUAGES PRACTICUM** I, II(3,0)3
The student will study a specific higher level language such as ADA, LISP, ALGOL, or SNOBOL. The student will be expected to write several programs of moderate complexity in the language selected. Prerequisite: permission of chairperson.
- 92-474 **DATA BASE MANAGEMENT** II(3,0)3
An introduction to Data Base software. The structures and examples of existing systems. The computer facility will be used to illustrate some of the concepts of the software. Prerequisite: two semester of higher level language excluding BASIC.
- 92-475 **MATHEMATICAL LOGIC** I(3,0)3
Propositional and statement logic. A rigorous development of the science of deductive logic with an emphasis on the nature of the logical structure underlying mathematical systems. Prerequisite: 92-221.
- 92-477 **MANAGEMENT INFORMATION SYSTEMS I** I(3,0)3
Analysis and evaluation of third generation integrated software systems including hardware for requirements, routine and demand reports, architectural evaluation for integrated business function control and the data base design.
- 92-478 **MANAGEMENT INFORMATION SYSTEMS II** II(3,0)3
Automated decision-making models, systems user consideration, the economics of MIS including effects on management organization, personnel, and data management. Prerequisite: 92-447.
- 92-481 **OPERATIONS RESEARCH I** I(3,0)3
General Linear Programming Problem, Simplex Method, Duality and Sensitivity Analysis, Transportation and Network problems, Dynamic Programming Integer (Linear) Programming, PERT. Prerequisite 92-221.

92-482 OPERATIONS RESEARCH II

II(3,0)3

Probability review (moment generating functions and Z-transforms). Inventory models, Queuing Theory. Markov Chains and Decision Models. Nonlinear Programming. Prerequisite 92-481.

92-483 APPLIED STATISTICAL METHODS

I(3,0)3

The development of statistical techniques without the use of calculus. Analysis of variance, multiple and curvilinear regression, tests for proportions, analysis of covariance, nonparametric methods. Prerequisite: 92-383, 385, 386, or 308.

92-484 DESIGN OF EXPERIMENTS

II(3,0)3

Methods of statistical analysis applied to various designs. Complete and randomized block designs, Latin squares, factorial experiments and confounding, incomplete designs and missing data, analysis of covariance, split plots, variance stabilizing transformations. Prerequisite: 92-483.

Directed Studies

Directed studies courses are available only to mathematics majors and may be elected provided that (1) the material to be covered is not available in any other mathematics course, (2) instructors are willing to undertake a directed studies, and (3) no more than 9 credits in mathematics are acquired through directed studies courses.

92-490 DIRECTED STUDIES IN COMPUTER SCIENCE

I, II(3,0)3

Individual study for the student desiring more advanced or more specialized work in computer science. May be repeated for a total of 6 semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of department chairperson.

92-491 DIRECTED STUDIES IN ANALYSIS

I, II(3,0)3

Individual study for the student desiring more advanced or more specialized work in analysis. May be repeated for a total of 6 semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of department chairperson.

92-492 DIRECTED STUDIES IN ALGEBRA

I, II(3,0)3

Individual study for the student desiring more advanced or more specialized work in algebra. May be repeated for a total of 6 semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of department chairperson.

92-493 DIRECTED STUDIES IN GEOMETRY

I, II(3,0)3

Individual study for the student desiring more advanced or more specialized work in geometry. May be repeated for total of 6 semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of department chairperson.

Primarily for Graduate Students

All graduate courses are open to undergraduate students with permission of the instructor.

92-501, 502 REAL ANALYSIS I, II

I(3,0)3 II(3,0)3

Real and complex number systems. Set theory. Bolzano-Weierstrass and Heine-Borel theorems. Sequences and series. Continuity. Differentiation. Riemann integration. Sequences and series of functions. Functions of several variables. Measure and integration.

92-503, 504 APPLIED FUNCTIONAL ANALYSIS

I(3,0)3 II(3,0)3

Vector spaces, metric spaces, normed spaces, Banach and Hilbert Spaces. Applications to integral and differential equations and approximation theory. Spectral theory of linear operators, compact operators, and unbounded linear operators. Applications to quantum mechanics - states, observables, Heisenberg Uncertainty Principle, Schrodinger equation, and Hamilton operator.

92-511, 512 COMPLEX ANALYSIS I, II

I(3,0)3 II(3,0)3

Complex numbers and their geometric representation, linear functions, power series, analytic functions, and conformal mapping, elementary functions, complex integration and integral theorems. Series and the expansion

of analytic functions in series, singularities, single-valued functions, entire functions, metamorphic functions, periodic functions.

92-521, 522 ALGEBRAIC STRUCTURES I, II

I(3,0)3 II(3,0)3

Properties of rings, groups, and modules in the framework of categorical algebra. Divisibility theory in integral domains. Linear and multilinear algebra. Field extensions and Galois theory. Homology groups.

92-537, 538 VECTOR AND TENSOR ANALYSIS I, II

I(3,0)3 II(3,0)3

The geometry of curves and surfaces, Serre-Frenet formulas, intrinsic equations of a curve, first and second fundamental forms of a surface, divergence, curl, and gradient. Tensor algebra, covariant and contravariant tensors, covariant differentiation and parallel displacement. Applications to differential geometry and selected topics.

92-539, 540 DIFFERENTIAL FORMS AND THEIR APPLICATIONS I, II

(3,0)3

Vector calculus; curves and surfaces; differential forms as multilinear maps; the gradient, curl, and divergence as exterior derivatives; the general Stokes' Theorem; applications to electrodynamics and thermodynamics.

92-543, 544 ORDINARY DIFFERENTIAL EQUATIONS I, II

I(3,0)3 II(3,0)

Existence and uniqueness theorems. Linear systems. Asymptotic behavior. Oscillation and comparison theorems. Plane autonomous systems. Non-linear systems. Stability theory and perturbation theory. Topics in optimal control theory. Other topics of current interest.

92-545, 546 PARTIAL DIFFERENTIAL EQUATIONS I, II

I(3,0)3 II(3,0)

First and second order partial differential equations, transformation theory in the plane and space. Applications to mathematical physics. Classification and methods of solution. Properties of solutions of equations with initial and boundary conditions. Existence and uniqueness theorems.

92-547 INTEGRAL EQUATIONS

I(3,0)3

Exact, iterative, and numerical techniques for the solution of linear Volterra and Fredholm integral equations, theorems for general operators. Symmetric kernels, orthogonal system of functions, and the Hilbert-Schmidt theorem. Relation of integral equations to differential equations, applications of the Rayleigh-Ritz, Galerkin and variation-iteration techniques to the solutions of eigenvalue-eigenfunction problems occurring in mathematical physics and engineering.

92-551 CALCULUS OF VARIATIONS

I(3,0)3

The first variational problem: necessary conditions. Euler's equation. Generalization to several dependent and independent variables. Constraints and Lagrange multipliers. Application to dynamics and elasticity. Hamilton equations. Sturm-Liouville problems, direct methods. Rayleigh-Ritz method.

92-553 SYSTEMS SIMULATION AND MODELING

II(3,0)3

Procedures in model construction and computerized simulation, modeling tools and techniques, model conceptualization and implementation, selected applications of simulation. Prerequisite: knowledge of Fortran and Assembly language.

92-559 ARTIFICIAL INTELLIGENCE

An examination of the techniques and procedures involved in the production of intellectually behaving computer programs. The student will learn to plan and construct programs which "learn" from their own experience. The aim of the course is to enable students to understand what a computer program can do to analyze information, develop strategies and make decisions. Prerequisite: Assembly language.

92-560 DATA STRUCTURES

Basic concepts of data. Linear lists, strings, arrays and orthogonal lists. Trees and graphs. Storage systems and structures. Storage allocation and collection. Multilinked structures. Symbol tables searching and sorting (ordering) techniques. Prerequisite: some mathematical maturity and PASCAL

92-561 APPROXIMATION THEORY

I(3,0)3

Approximation techniques for functions. Interpolation, rational approximation, orthogonal functions.

92-563 NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS

I(3,0)3

Solution of non-linear equations. Interpolation. Numerical differentiation and integration. Initial value problems. Boundary value problems-introduction. Parabolic differential equations-introduction.

- 92-564 NUMERICAL ALGEBRA AND APPROXIMATION THEORY** II(3,0)3
 Solution of linear systems. Eigenvalue, eigenvector problem. Fast Fourier Transform. Introduction to finite elements. Least squares. Splines. Chebychev approximation.
- 92-565 FORMAL LANGUAGES** I(3,0)3
 This course will study the formal or abstract properties of (computer) languages and of acceptors/recognizers for valid expressions in the syntax of the languages. Topics to be covered will include: the Choamsky hierarchy of languages. Finite State Machines: their basic properties/results and as acceptors for Regular Expressions. Two-way Acceptors and Automata, Pushdown Automata: acceptors for Context Free Languages and grammars for Pushdown Automata. Context Free Grammars. Transformations on grammars and canonical forms for grammars. Syntax Analysis: top-down, bottom-up and precedence analysis. Parsing. Turing Machines. Prerequisite: PASCAL
- 92-566 THEORY OF COMPUTATION** II(3,0)3
 Models of computation. Turing machines and Turing-computable functions. Other models of computation. The Church-Turing thesis. Universal machines. Recursive functions, primitive recursive and partial recursive functions. Simulation of various computations. Recursive and recursively enumerable sets. Unsolvable problems: Computable versus non-computable functions, Halting problem, equivalence problem, word problems, etc. Other topics as time and interest permit. Prerequisite: PASCAL.
- 92-567 SYSTEMS PROGRAMMING**
 Systems software as concerned with language processors: assemblers, macro processors, compilers. Review of relevant data structures and utilities. Review of relevant issues in language theory and design: block structure, symbol binding, etc. Assemblers. Compilation: lexical, syntactic and semantic analysis. Code generation. Optimization. Parsers and parsing techniques. Prerequisite: Assembler Language and Data Structures.
- 92-568 OPERATING SYSTEMS** II(3,0)3
 Models of operating systems: resource manager, process, hierarchical model and extended machine. Systems structure: operating systems structure, software/hardware tradeoffs. Processes: parallelism/concurrency, deadlock, mutual exclusion. Process synchronization. Control: scheduling, interrupts, priority. Multi-programming. Memory management: paging, segmentation, virtual memory. Name management. Resource allocation: memory, CPU scheduling, queueing, etc. File structures. Protection. Prerequisite: Assembler Language and Data Structures.
- 92-569 COMPILER CONSTRUCTION TECHNIQUES** II(3,0)3
 Typical compiler organization is studied including symbol tables, various types of scans, object code generation, error diagnostics, and optimization techniques. Segments of a classroom compiler are written by students. Prerequisites: PASCAL AND DATA STRUCTURES.
- 92-570 DATA COMMUNICATIONS** II(3,0)3
 Analysis and use of remote computing systems including time-sharing remote batch and real-time systems. Design characteristics, applications, data communication, economics and management of such systems. Prerequisites: PASCAL and Data Structures
- 92-571, 572 OPTIMIZATION AND MATHEMATICAL PROGRAMMING** I(3,0)3 II(3,0)3
 Linear programming, simplex methods, dual problem, transportation problem, assignment problem, sensitivity analysis, introductory integer programming and application of each of the techniques. Second semester covers integer programming network flows and analysis, classical nonlinear optimization. Lagrange multipliers. Kuhn-Tucker conditions, nonlinear programming and some calculus of variations.
- 92-574 DATA BASE MANAGEMENT** I, II(3,0)3
 An introduction to Data Base software. The structures and examples of existing systems. The computer facility will be used to illustrate some of the concepts of the software. Prerequisite: Permission of program coordinator.
- 92-575 ANALYSIS OF ALGORITHMS** II(3,0)3
 Basic steps in developing an algorithm, correctness, algorithm design techniques such as hill climbing, subgoals, heuristics, backtracking, branch and bound, recursion, sorting and searching, paging, parallelism. Algorithm and program correctness: measures of algorithm efficiency, complexity and overall effectiveness. Prerequisite: 92-560.

92-578 PROGRAMMING LANGUAGE II**II(3,0)3**

An intensive examination of the COBOL language with a focus on structured programming techniques, including an examination of the COBOL DATA and PROCEDURE divisions. Emphasis will be placed on sequential and random access files, the COBOL procedure verbs, and the SORT/MERGE and REPORT WRITER modules. Prerequisite: A higher level language.

92-579 ORGANIZATION OF PROGRAMMING LANGUAGES

A discussion of the principle of organizations and design of programming languages, Language Definition and Specification, Cobol structures, Data Structures and Types. Emphasis on principle and structures as illustrated in several languages instead of language syntax. Examples chosen for ADA, LISP, PASCAL, MODULE, SIMULA, PL/I, etc. Prerequisite: 92-321, PASCAL.

92-580 COMBINATIONS

A discussion of enumerative combinations and combinatorial algorithms. Elementary considerations, sum and product rule, permutations and combinations, binomial coefficients, perhans distributions generating functions and recurrence relations. Inclusion/exclusion, polyais theoem, experimental design, and finite geometries coding. Topics form graph theory, complexity of computation. Emphasis on applications, especially in computer science. Prerequisite: 92-321, PASCAL.

92-581 GRAPH THEORY

Discussion of theory and application of graphs and network models. Basic concepts of definitions of graphs and directed graphs paths, connectedness, isomorphism and planarity. Trees and spanning trees; applications and the sorting problem. Shortest path, flow, spanning tree algorithms; circuits and applications; coloring problems. Prerequisite: 92-321.

92-582 REGRESSION AND TIME SERIES**II(3,0)3**

The method of least squares as applied to various types of regression, including multilinear, polynomial, and exponential. Time series, estimation, smoothing, forecasting. Trends and seasonal effects.

92-584 STOCHASTIC PROCESSES**II(3,0)3**

Stationary and independent increments, Marhov chains and processes, recurrence and absorption, random walks, poisson processes, queuing theory, and martingales. Prerequisite: 92-307 or 92-587

92-585 QUEUEING THEORY**I(3,0)3**

A development of the theory and utilization of queueing models. Thorough investigation of the M/M/1 and M/G/1 models and salient results from other cases. Examples from inventory control, scheduling, communications reliability, staffing and computer science applications. Formulation of queueing models and solutions using exact methods, approximations and simulation. Prerequisite: statistics and probability.

92-586 CODING THEORY**II(3,0)3**

Error correcting and decoding with selected topics from information theory and cryptography, with emphasis on practical applications in data processing, transmission and security. Linear block codes, cyclic codes, convolution codes and arithmethic codes. Applications from communications and computer science. Prerequisite: 92-321.

92-587, 588 MATHEMATICAL STATISTICS I, II**I(3,0)3 II(3,0)3**

Random variables, densities, joint and conditional distributions, expectation, variance, estimation, sufficiency and completeness, hypothesis testing, limiting distributions.

92-590 COMPUTER NETWORKS AND DISTRIBUTED COMPUTER SYSTEMS

Network taxonomy, network switching, routing, functions and components, control procedures and protocols, network architectures, models, SNA, distributed processing, distributed data base systems, task partitioning, resource sharing, interprocess communications, synchronization, file allocation and dead lock problem, security, recovery. Prerequisite: Data communications or equivalent.

92-651, 652 SELECTED TOPICS**I(3,0)3 II(3,0)3**

Advanced topics in various fields of mathematics. Content may vary from year to year. Permission of graduate coordinator required.

92-800 SURVEY OF ANALYSIS**I(3,0)3**

Includes topics in Analysis and/or Mathematics in general. (This course is specifically designed for the certificate program. Its contents will vary with student needs.)

92-802 SURVEY OF MATHEMATICS

I(3,0)3

Continuation of 92-800.

92-801 ANALYSIS

I(3,0)3

Calculus from an advanced viewpoint. The course is designed to provide teachers with the background necessary to teach Advanced Placement Mathematics. (This course is specifically designed for the teacher option).

92-813 THEORY OF NUMBERS

I(3,0)3

Study of primes, congruences, number-theoretic functions, Dirichlet series, quadratic forms and quadratic number fields. Additional topics as time permits.

92-821, 822 LINEAR ALGEBRA I, II

I(3,0)3 II(3,0)3

Mathematical induction; the properties of sets; Mappings and mathematical logic, vectors in $\mathbb{R}^n$; vector spaces, matrices; linear mappings; the effect of a change of basis; the matrix associated with a linear map; applications. Scalar products and orthogonality; matrices and bilinear maps; polynomials and matrices; triangulation of matrices and linear maps; the Spectral Theorem; matrix analysis; applications.

92-841 GEOMETRIES I

I(3,0)3

Euclid's and Hilbert's axioms; non-Euclidean geometrics, the space concept and an introduction to basic topological concepts.

92-843 GEOMETRIES II

I(3,0)3

A continuation of Geometries I; synthetic and analytic treatment of projective transformations, duality, conics poles, involution.

92-871 PROGRAMMING LANGUAGES I

I(3,0)3

An introduction to the formal concepts of programming languages including specification of syntax and semantics. Examination of programming languages (FORTRAN, COBOL, BASIC, APL). The University's computer will be used for processing of practice problems.

DEPARTMENT OF PHYSICS & APPLIED PHYSICS

Zoltan Fried, Chairperson

Professors: Edward L. Alexander, Albert Altman, Adolph Baker, Leon E. Beghian, George L. Carr, C. Daniel Cole, Gus P. Couchell, James J. Egan, Zoltan Fried, F. Raymond Hardy, Jesse Y. Harris, Lloyd C. Kannenberg, Aram Karakasian, Gunter H. R. Kegel, Anthony Liuzzi, Suresh C. Mathur, David J. Pullen, Walter A. Schier, Kunnat J. Sebastian, Eric Sheldon, Kenneth W. Skrabble, Malcolm K. Smith, Martin Wilner.

Associate Professors: Luther C. Barcus, Padmanabh Harihar, Thomas V. Marcella, Roger D. McLeod, Walter R. Mellen, Arthur Mittler, Paul J. Ring, Richard W. Stimets, Ye-Yung Teng, Jerry Waldman, Chuen Wong.

Assistant Professor: Alexander Sachs.

The Department of Pure and Applied Physics offers majors in physics (with options in pure physics, applied physics, and optics) and radiological sciences and protection which lead to the Bachelor of Science degree. The department also offers a minor area of study in physics.

Transfer Policies and Equivalency Examinations

The policy of the Department of Physics and Applied Physics with regard to course equivalency examinations and transfer of credits is as follows:

The Department will give no course equivalency examinations.

Upon presentation of a transcript, from an American or foreign institution judged to have equivalent or better instruction in Physics, showing satisfactory performance in a course, or courses, judged to provide adequate background in the subject, the Department will authorize the transfer of credit as a substitute for the appropriate courses offered in this department.

A passing grade in comprehensive examinations, such as the British A-level examinations, or their derivatives, will be taken as evidence that the student has taken a course equivalent to that offered by the University of Lowell.

Upon presentation of a transcript from a university or college about which we have inadequate information, or, in the case of justifiable extenuating circumstances, a certificate showing graduation in a field normally requiring Physics in its curriculum, the Department may authorize the student to take an examination in each of the courses for which transfer credit is requested; and upon certification by the examiner that he/she has shown adequate comprehension of the subject matter, the Department may recommend that the student be allowed to transfer credits, as specified.

In unusual cases, where the student is unable to present a certificate, but the Department believes that the student is acting in good faith in stating that he/she has taken appropriate courses in Physics, but is unable to produce the required certificate, the Department may allow this student to take an examination, as in (3), above.

Transfer credit in laboratory courses will be allowed only in cases falling within (2), above. In all other cases, the student must take laboratory courses.

Physics Major

Physics is the study of the fundamental laws of nature which govern the behavior of all matter. The major serves a variety of goals and interests and provides a broad, comprehensive background in both experimental and theoretical physics which will prove useful for science-oriented careers in business and industry, for subsequent graduate work in professional schools of business, education, law, medicine, and public administration, and for continued study at the master's and doctor's levels. Because of the precise and theoretical nature of physics, students who plan to major in this discipline must possess a high level of mathematical competence.

Program options permit the student to select a structured curriculum in pure physics which provides rigorous training in both theoretical and experimental physics or a more flexible curriculum in applied physics which permits the student to apply his or her knowledge of physics to another science or to technological and professional fields. Both the pure and applied physics options provide the essential content of undergraduate physics and successful completion of either program will provide good preparation for graduate work in physics or in one of the fields in which the student may wish to apply his or her physical knowledge.

A supplementary concentration in optics may be elected by students under either the pure or applied physics option. This program provides intensive laboratory and theoretical training in preparation for a career following the BS degree in such rapidly expanding fields as optical instrumentation, metrology, lasers and other optical devices and image processing, and is also suitable for students anticipating graduate study in optics, physics, astronomy, and engineering.

The pure physics option provides the student with a competitive advantage in areas of physics which deal with both theoretical and experimental concepts and hence may prove more immediately valuable to the student who, following graduation, desires to initiate graduate work in physics or to pursue a career in which a broad theoretical and experimental background in physics is required.

The applied physics option consists of a required physics sequence and a supplementary program from the following areas: biology, business administration, chemistry, engineering, environmental science, optics, radiological health physics, or technology. The applied physics option provides the student who has a clear understanding of career objectives with an early opportunity to integrate personal goals with the study of physics and undoubtedly will have immediate relevancy for the student who desires to pursue a career in research and development or who wishes to initiate graduate studies in any of the applied physics disciplines following the completion of undergraduate studies.

Both the pure and applied physics curricula involve a common freshman year, at the end of which the student normally is expected to consult his or her faculty advisor and to make a choice of program. The physics major is offered under the requirements of the College of Pure and Applied Sciences for the Bachelor of Science degree. A grade-point average of 2.00 or better is required in physics (courses with prefixes of "95", and "96") for graduation.

Summary of Degree Requirements

I University Core Requirements	23
Physical Education	2
English Composition	6

Area I (Behavioral & Social Sciences)	6-9*
Area II (Fine Arts & Humanities)	6-9*
Area III (Mathematics & Sciences)	(12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirements. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area.

+ Area III requirement is satisfied by specified science and mathematics courses of the Major Field Requirements for Supporting Sciences & Mathematics.

II Option in Pure Physics -	103 cr.	A. Major Field Requirements	88 cr.
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I. Physics (95 and 96 Prefix)	57 cr.
95-141 Physics I	3
95-144 Physics II	3
96-147 Fundamentals of Experimental Physics (I) (Honors)	1
96-148 Fundamentals of Experimental Physics II (Honors)	1
95-209 Electricity and Magnetism I	4
95-210 Introductory Modern Physics	4
96-257 Physical Instrumentation	2
96-293 Experimental Physics I	3
96-294 Experimental Physics II	3
95-313 Mechanics	4
95-335 Introductory Quantum Mechanics I	3
95-336 Introductory Quantum Mechanics II	3
95-338 Physical Optics*	3
95-353 Electromagnetism I	3
95-354 Electromagnetism II	3
96-393 Intermediate Physics Laboratory I +	2
96-394 Intermediate Physics Laboratory II +	2
95-421 Statistical Thermodynamics	4
95-461 Topics in Nuclear Physics	3
95-472 Topics in Solid State Physics	3
I. Supporting Science and Mathematics	31 cr.
84-121 Chemistry	3
84-122 Chemistry	3
84-123 Chemistry Laboratory	1
84-124 Chemistry Laboratory	1
92-131 Calculus B-I	4
(or 92-133 Calculus A-I)	(4)
92-132 Calculus B-II	4
(or 92-134 Calculus A-II)	(4)
92-207 Mathematical Techniques of Physics I	4
92-208 Mathematical Techniques of Physics II	4
92-310 Mathematical Techniques of Physics III	4
80-397 Computer Programming and Applications +	3

B. Elective Courses:	15 cr.
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Upon the approval of faculty advisors, students may elect courses from the offerings of the University which are suitable to their needs and interests. At least 3 credits must be elected from course offerings in behavioral, and social sciences, fine arts, and humanities. These credits are in excess of those which are presented for Area I and II of the University Core Requirements.

III Option in Applied Physics -	103 cr.	A. Major Field Requirements	80 cr.
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I. Physics (95 and 96 Prefix)	49 cr.
95-141 Physics I	3
95-144 Physics II	3
96-147 Fundamentals of Experimental Physics (I) (Honors)	1
96-148 Fundamentals of Experimental Physics II (Honors)	1
95-209 Electricity and Magnetism I	4
95-210 Introductory Modern Physics	4
96-257 Physical Instrumentation	2
96-293 Experimental Physics I	3
96-294 Experimental Physics II	3
95-310 Electricity and Magnetism II	4
95-313 Mechanics	4
95-335 Introductory Quantum Mechanics I	3
95-336 Introductory Quantum Mechanics II	3
95-338 Physical Optics*	3
96-393 Intermediate Physics Laboratory I +	2
96-394 Intermediate Physics Laboratory II +	2
95-421 Statistical Thermodynamics	4

1. Supporting Science and Mathematics	31
84-121 Chemistry	3
84-122 Chemistry	3
84-122 Chemistry Laboratory	1
84-123 Chemistry Laboratory	1
84-124 Chemistry Laboratory	1
92-131 Calculus B-I (or 92-133 Calculus A-I)	(4)
92-132 Calculus B-II (or 92-134 Calculus A-II)	(4)
92-207 Mathematical Techniques of Physics I	4
92-208 Mathematical Techniques of Physics II	4
92-310 Mathematical Techniques of Physics III	4
80-397 Computer Programming and Applications +	3

B. Supplementary Area 18.

Students pursuing the applied physics option are required to complete 18 credits in one of the following fields: biology, business administration, chemistry, engineering, environmental science, optics, radiological health physics, or technology. Students who elect a supplementary area in optics complete 80-337, 96-337 (substitutes for 96-393), 80-338, 96-338 (substitutes for 96-394), 80-439, 96-439, 80-440, and 96-440. Students who present the optics sequence may present 96-337 in lieu of 96-393 and 96-338 in lieu of 96-394.

C. Elective Courses

Upon the approval of their faculty advisors, students may elect courses from among the offerings of the University which are suitable to their needs and interests. At least one elective must be selected from among the course offerings in behavioral and social sciences, fine arts, and humanities. Students who elect the supplementary area in optics must select an additional 6 credits of electives.

IV Minimum Credit Requirements 126 cr.

#Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences may not be credited to requirements for degrees in the College of Pure and Applied Sciences. All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the College of Pure and Applied Sciences.

*Students electing the supplementary area in optics may substitute 80-338 for 95-338.

+Students completing the supplementary area in optics may substitute 96-337 for 96-393 and 96-338 for 96-394.

†Another computer science course approved by the faculty advisor may be substituted for this course.

‡Another thermodynamics course approved by the faculty advisor may be substituted for this course.

§Students in the pure physics option are urged to include six credits in a single foreign language (French, German, or Russian) in their programs.

Physics Minor

A minor in physics consists of 24 credits and must include either Sequence I or Sequence II as specified below plus additional courses from Group III and a minimum of 6 credits from course offerings in physics at the 300-400 level. The courses at the 300-400 level must:

- be other than ones required by the student's major department, and
- not include 80-301, 80-302, 80-342, 80-397, 80-398, 95-385, 95-386.

Sequence I: 95-141, 96-141, 95-144, 96-144, 95-245, and 96-245.

Sequence II: 95-145, 96-145, 95-146, and 96-146.

Sequence III: 95-235, 96-235, 96-293, 96-294, 80-201, 80-202, 80-206.

Radiological Health Physics Major

The radiological health physics program is designed to provide needed professional personnel to assist in the advancement of the safe utilization of nuclear energy radiation. The academic program, which is broadly based in the sciences and includes specialized training and internship programs, stresses the complex interrelationships of scientific knowledges and technological skills which are fundamental to the solution of problems of radiation safety and control. Summer programs, which are established in cooperation with nuclear and radiation facilities of the University of Lowell, government laboratories, and major hospitals, provide experience with equipment methods which are characteristic of current techniques and philosophies of professional practice in the radiation protection field and assist students in selecting professional positions after graduation or in determining areas of interest for advanced graduate work or research.

Summary of Degree Requirements

I. University Core Requirements	23
Physical Education	2
English Composition	6

Area I (Behavioral & Social Sciences)
 Area II (Fine Arts & Humanities)
 Area III (Mathematics & Sciences)

6-9*
 6-9*
 (12) +

*A minimum of two courses and six credits must be presented in each of the three areas of the University Core Requirements. An additional three courses and nine credits must be presented from among the three areas of the University Core Requirement. Students may not present more than three courses and nine credits from the offerings of any one department (except that not more than two courses and six credits may be presented from the offerings of the English Department) and may not present more than four courses and twelve credits in any one distribution area. + Area III requirement is satisfied by specified science and mathematics courses of the Major Field Requirements for Supporting Sciences and Mathematics.

II Major Field Requirements- 74-76

A Radiological Health Physics 42

16-211 Fundamentals of Electricity	3
95-141 Physics I	3
96-141 Fundamentals of Experimental Physics I	1
95-144 Physics II	3
96-144 Fundamentals of Experimental Physics II	1
95-245 Physics III	3
96-245 Fundamentals of Experimental Physics III	1
98-101 Introduction to Radiological Sciences I	1
98-102 Introduction to Radiological Sciences II	1
98-401 Radiation Safety and Control I	4
98-402 Radiation Safety and Control II	4
98-422 Environmental Radiation and Nuclear Site Criteria	3
98-472 Radiation Biology	3
80-201 Physics of Radiation	3
80-202 Physics of Nuclei	3
24-231 Nuclear Instrumentation I	1
80-305 Nuclear Instrumentation II	4

B. Supporting Sciences and Mathematics 32-34

84-121 Chemistry	3
84-123 Chemistry Laboratory	1
84-122 Chemistry	3
84-124 Chemistry Laboratory	1
81-111 Principles of Biology I	3
81-112 Principles of Biology II	3
81-252 Mammalian Physiology	3
81-254 Mammalian Physiology Laboratory	1
92-133 Calculus A-I or	4
92-131 Calculus B-I	(4)
92-134 Calculus A-II or	4
92-132 Calculus B-II	(4)
92-133 Calculus A-III or	3
92-231 Calculus B-III	(4)
92-234 Differential Equations	3
III Allied Courses and Electives	
42-225 Technical & Scientific Writing	3
84-484 Elements of Radiochemistry	3
92-263 Fortran Programming	3
Electives	21

127

IV. Minimum Credit Requirement

-Prerequisites for courses of the Major Field Requirements, or courses which are prerequisites for admission to the College of Pure and Applied Sciences, may not be credited to requirements for degrees in the College of Pure and Applied Sciences. All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the College of Pure and Applied Sciences.

Radiological Health Physics Minor

A minor in radiological health physics consists of a minimum of 18 credits and must include:

98-101 Introduction to Radiological Sciences	1
or	or
99-101 Radiation and Life	3
98-201 Health Physics Internship I	3
or	
98-202 Health Physics Internship II	3
98-422 Environmental Radiation & Nuclear Site Criteria	3
98-441 Radioisotope Techniques	3
98-443 Radioisotope Techniques Laboratory I	1
98-472 Radiation Biology	3

The other courses to meet the minimum credit requirement may be chosen from any course offerings with a 98 prefix.

SAMPLE COURSE OF STUDY FOR PHYSICS - PURE PHYSICS OPTION#

(Bachelor of Science Degree)

Freshman Year

Fall Semester		Spring Semester	
42-101 College Writing	3	42-102 College Writing & Literature	3
*84-121 Chemistry	3	*84-122 Chemistry	3
*84-123 Chemistry Laboratory	1	*84-124 Chemistry Laboratory	1
*92-133 Calculus A-I	4	*92-134 Calculus A-II	4
+ 95-141 Physics I	3	+ 95-144 Physics II	3
+ 96-147 Fundamentals of Experimental Physics I (Honors)	1	96-148 Fundamentals of Experimental Physics II (Honors)	1
39- Physical Education	1	39- Physical Education	1
	16		16

Sophomore Year

Fall Semester		Spring Semester	
92-207 Mathematical Techniques of Physics I	4	92-208 Mathematical Techniques of Physics II	4
95-209 Electricity and Magnetism I	4	95-210 Introductory Modern Physics	4
96-293 Experimental Physics I	3	80-397 Computer Programming and Applications	3
96-257 Physical Instrumentation	2	96-294 Experimental Physics II	3
Elective	3	Elective	3
	16		17

Junior Year

Fall Semester		Spring Semester	
92-310 Mathematical Techniques of Physics II	4	95-313 Mechanics	4
95-335 Introductory Quantum Mechanics I	3	95-336 Introductory Quantum Mechanics II	3
95-353 Electromagnetism I	3	95-354 Electromagnetism II	3
96-393 Intermediate Physics Laboratory I	2	96-394 Intermediate Physics Laboratory II	2
Elective	3	Elective	3
	15		15

Senior Year

Fall Semester		Spring Semester	
95-421 Statistical Thermodynamics	4	95-472 Topics in Solid State Physics	3
95-461 Topics in Nuclear Physics	3	Electives	9
Electives	9	**95-338 Physical Optics	3
	16		15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Cf. Summary of Degree Requirements for listings of approved alternative courses.

+ Appropriate honors courses may be substituted.

**Students electing the optics sequence will take 80-338 as part of that sequence in the Junior Year and may substitute courses in the optics sequence for 96-393 and 96-394.

SAMPLE COURSE OF STUDY FOR PHYSICS - APPLIED PHYSICS OPTION##

(Bachelor of Science Degree)

Freshman Year

Fall Semester		Spring Semester	
42-101 College Writing	3	42-102 College Writing & Literature	3
*84-121 Chemistry	3	*84-122 Chemistry	3
*84-123 Chemistry Laboratory	1	*84-124 Chemistry Laboratory	1
*92-133 Calculus A-I	4	*92-134 Calculus A-II	4
+ 95-141 Physics I	3	+ 95-144 Physics II	3
96-147 Fundamentals of Experimental Physics I (Honors)	1	Physics II (Honors)	1
39- Physical Education	1	39- Physical Education	1
	16		16

Sophomore Year

Fall Semester		Spring Semester	
92-207 Mathematical Techniques of Physics I	4	92-208 Mathematical Techniques of Physics II	4
95-209 Electricity and Magnetism I	4	95-210 Introductory Modern Physics	4
95-257 Physical Instrumentation	2	96-294 Experimental Physics II	3
96-293 Experimental Physics I	3	80-397 Computer Programming	3
Elective	3		
	16		17

Junior Year

Fall Semester

92-310	Mathematical Techniques of Physics III	4
95-335	Introductory Quantum Mechanics I	3
96-393	Intermediate Physics Laboratory I	2
	Elective	3
	Elective	3
		15

Spring Semester

95-310	Electricity and Magnetism II	4
95-336	Introductory Quantum Mechanics II	3
96-394	Intermediate Physics Laboratory II	2
95-313	Mechanics	4
	Elective	3
		16

Senior Year

Fall Semester

# 95-421	Statistical Thermodynamics	4
	Electives	12
		16

Spring Semester

	Electives	12
80-338	Physical Optics	3
		15

##Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Cf. Summary of Degree Requirements for listing of approved alternative courses.

+ Appropriate honors courses may be substituted.

#A different thermodynamics course may be substituted with the consent of the faculty advisor.

**Students electing the optics sequence will take 80-338 in the Junior Year as part of that sequence and may substitute courses in the optics sequence for 96-393 and 96-394.

SAMPLE COURSE OF STUDY FOR RADIOLOGICAL HEALTH PHYSICS*

(Bachelor of Science Degree)

Freshman Year

Fall Semester

42-101	College Writing	3
84-121	Chemistry	3
84-123	Chemistry Laboratory	1
92-133	Calculus A-I	4
95-141	Physics I	3
96-141	Fundamentals of Experimental Physics I	1
98-101	Introduction to Radiological Sciences I	1
39-	Physical Education	1
		17

Spring Semester

42-102	College Writing & Literature	3
84-122	Chemistry	3
84-124	Chemistry Laboratory	1
*92-134	Calculus A-II	4
95-144	Physics II	3
96-144	Fundamentals of Experimental Physics II	1
98-102	Introduction to Radiological Sciences II	1
39-	Physical Education	1
		17

Sophomore Year

Fall Semester

80-201	Physics of Radiation	3
81-111	Principles of Biology I	3
16-211	Fundamentals of Electricity	3
*92-233	Calculus A-III	3
95-245	Physics III	3
96-245	Fundamentals of Experimental Physics III	1
		16

Spring Semester

80-202	Physics of Nuclei	3
81-112	Principles of Biology II	3
24-131	Nuclear Instrumentation I	1
*92-234	Differential Equations	3
92-263	Fortran Programming	3
	Elective	3
		16

Junior Year

Fall Semester

80-305	Nuclear Instrumentation III	4
42-225	Technical & Scientific Writing	3
	Electives	6
		13

Spring Semester

84-484	Elements of Radiochemistry	3
81-252	Mammalian Physiology	3
81-254	Mammalian Physiology Laboratory	1
	Elective (Area I)	3
	Elective (Area II)	3
	Elective	3
		16

Senior Year

Fall Semester

98-401	Radiation Safety & Control I	4
	Elective (Area I)	3
	Elective (Area II)	3
	Elective (Area I or II)	3
	Elective	3
		16

Spring Semester

98-402	Radiation Safety & Control II	4
98-472	Radiation Biology	3
98-422	Environmental Radiation	3
	Electives	6
		16

*Cf. Summary of Degree Requirements for listings of approved courses. Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Applied Physics (Course Prefix: 80)

Since these courses deal with applications of physics to other disciplines, they are not acceptable toward meeting the requirements for the physics major.

- 80-111 THE PHYSICAL ENVIRONMENT I** I(3,0)3
A physical science course for students with majors outside the College of Pure and Applied Science. Topics involve the physical aspects of man's interaction with his terrestrial environment and include energy, traffic, noise, and safety.
- 80-112 THE PHYSICAL ENVIRONMENT II** II(3,0)3
A physical science course for students with majors outside the College of Pure and Applied Science. Topics deal with the application of physical principles to the atmosphere, the solar system, space travel, and the stars.
- 80-161 COMPUTATIONAL TECHNIQUES FOR PHYSICAL SCIENCES I** I(2,0)2
This course is designed to introduce freshmen students to computational techniques in the physical sciences using digital computers.
- 80-162 COMPUTATIONAL TECHNIQUES FOR PHYSICAL SCIENCES II** II(2,0)2
More advanced computational techniques in the physical sciences using digital computers. Prerequisite: 80-161 or equivalent.
- 80-201 PHYSICS OF RADIATION** I(3,0)3
A survey of modern physics including the special theory of relativity, the particle nature of electromagnetic radiation, the wave aspects of material particles, the hydrogen atom, many-electron atoms, and molecular and solid state physics. Prerequisite: 95-144. Corequisite: 95-245 or 95-146.
- 80-202 PHYSICS OF NUCLEI** II(3,0)3
A survey of nuclear physics including static properties of nuclei, natural radioactivity, artificial nuclear disintegration, artificial radioactivity, alpha, beta, and gamma decay, nuclear structure, nuclear reactions, and interactions with matter. Prerequisite: 80-201.
- 80-206 NUCLEAR INSTRUMENTATION I** II(2,4)4
Lecture: Fundamentals of electronic circuits and devices as applied to digital and analog circuits encountered in instrumentation systems. Laboratory: basic measurement techniques; use of the oscilloscope; characteristics of transistors, diodes, and integrated circuits; feed-back and operational amplifiers; digital circuits; logic; the micro-processor. Prerequisite: 95-146 or 95-245.
- 80-237 THE PHYSICAL PRINCIPLES OF PHOTOGRAPHY** I,II(3,0)3
This course is designed to give a semi-quantitative treatment to the technical aspects of photography. It is not intended to emphasize the creative expression or darkroom techniques, but rather the technical factors that affect the making of black and white and color photographs. Topics to be covered include elementary optics, lenses, shutters, camera types, film images, film speeds, chemistry of development, prints, color photography and special applications. A knowledge of elementary high school algebra is desirable.
- 80-251 THE PHYSICS OF HIGH FIDELITY** I,II(3,0)3
The course examines the physical principles underlying the design of high fidelity system components and recordings. Topics covered include the properties of waves, an analysis of musical sound principles of static and current electricity, magnetism, electromagnetic waves and the laws of mechanics. These basic physics ideas will be incorporated into a description of the operating principles of: loudspeakers, preamplifiers and control centers, power amplifiers, turntables, moving-magnet and moving-coil phono-cartridges, open reel, cassette and cartridge tape recorders, microphones, headphones, four-channel sound systems, equalizers, Dolby and other noise reduction systems, dynamic range-expanders, time-delay ambience simulation devices, tuners, and radio broadcasting. The course will enable even the non-science oriented student to evaluate and understand the jargon filled specification sheets for hi-fi equipment. It will therefore entail consumer education useful to anyone contemplating the expenditure of a substantial sum of money on equipment with which he or she may live for many years. A knowledge of elementary high school algebra is desirable.
- 80-301 LABORATORY PRACTICUM IN PHYSICS I** I(1,3)1
A course for students preparing to teach physics at any level. Through observation, preparation of materials, and presentation of demonstrations in introductory course laboratories, the student becomes familiar with the materials and the teaching-learning situation in physical science. Prerequisite: junior status as a major in physics or applied physics.
- 80-302 LABORATORY PRACTICUM IN PHYSICS II** II(1,3)1
A continuation of 80-301. Prerequisite: junior status as a major in physics or in applied physics.

80-305 NUCLEAR INSTRUMENTATION II**I(2,4)4**

An integrated laboratory and lecture course covering the operating principles and applications of nuclear radiation detectors, associated electronic signal processing equipment, and data analysis techniques. Topics covered include charged-particle, photon and neutron detection, as well as charged-particle and gamma-ray spectroscopy. The laboratory involves the use of scintillators, photomultiplier tubes, solid state detectors, gas-filled counter, a variety of electronic instrumentation including oscilloscopes and experiments utilizing the Pinasky Nuclear Center's 1MW nuclear reactor. Prerequisites: 80-202, 80-206.

80-337 GEOMETRICAL OPTICS**I(3,0)3**

Properties of light, plane surfaces and prisms, thin and thick lenses, mirrors and stops, matrix methods applied to Gaussian (paraxial) optics, Lagrange-Helmholtz invariant, primary and chromatic aberrations, ray tracing and Abbe's sine condition, basic optical instruments including cameras, telescopes and microscopes. Prerequisite: 95-146 or 95-245.

80-338 PHYSICAL OPTICS**II(3,0)3**

Wave nature of light, mathematics of wave motion, electromagnetic theory of light propagation, reflection and refraction, Fresnel coefficients, polarization, interference, Young's experiment, fringe visibility and coherence, various interferometers, Newton's rings and applications, Fraunhofer diffraction by single and multiple apertures and diffraction gratings, Fresnel diffraction. Prerequisite: 80-337

80-381 PHYSICAL ACOUSTICS**I,II(3,0)3**

Oscillations. Vibrations and strings. Plane sound waves. Spherical waves and radiation. Sound sources. Sound detectors. Sound recording. Speech, hearing noise, and communication. Acoustics in architecture. Acoustic measurements and instruments. Ultrasonics. Underwater sound. Prerequisites: 92-208, 95-144.

80-397 COMPUTER PROGRAMMING AND APPLICATIONS I**I(3,0)3**

Overview on the use of modern digital computers. Principles of FORTRAN-4 including flowcharts, arithmetic, relational, and specification statements. DO-loops, functions, and subroutines, application of computer techniques to solve physical problems ex. analysis of experimental data, Monte Carlo techniques. About 10 programs to be written and run on the Univ. computer system.

80-398 COMPUTER PROGRAMMING AND APPLICATIONS II**II(3,0)3**

Continuation of 80-397. Advanced topics in FORTRAN-4 including double precision, complex numbers and roundoff. Use of library routines and mass storage devices. Advanced techniques in experimental data analysis and simulation problems.

80-437 APPLIED OPTICS I**I(3,0)3**

Topics in applied optics including geometrical optics, optical design, aberration, lens design, radiometry, photometry, interferometry, optical testing and evaluation techniques.

80-438 APPLIED OPTICS II**II(3,0)3**

Continuation of 80-437.

80-439 OPTICAL PROPERTIES OF MATERIALS: RADIATION SOURCES AND DETECTORS I**I(3,0)3**

Optical properties of materials: Complex dielectric constant, isotropic and anisotropic media polarization, transmitting materials for visible applications, optical properties of metals.

Sources of electromagnetic radiation: Photometry, blackbody radiation, emission spectra of atoms and molecules, incoherent high intensity sources and applications, introduction to lasers as coherent light sources.

Detectors: Introduction to photoelectric effect semiconductor physics, photochemistry; application of basic principles to various detectors. Application of the above material to spectrometers and transmitter-receiver systems. Prerequisites: 80-337, 80-338. Corequisite: 96-439.

80-440 IMAGE PROCESSING**II(2,2)4**

Basic physics of television and other imaging systems; representation and manipulation of images in digital form; Fourier analysis and filtering of images; detection of image features such as edges and regions; pattern recognition; three dimensional visual perception in man and machine; examples of image processing tasks from such areas as medicine, industrial inspection and robotics; Laboratory exercises with an image processing system utilizing an Octec 2000 image analyzer and a Data General Nova 4/C computer. Ability to program a computer is required. Prerequisite: 80-337, 80-338.

80-441 APPLIED QUANTUM MECHANICS**I,II(3,0)3**

A medium-level treatment of quantum mechanics in a form designed for applications. Wave and matrix mechanics. Symmetry and group theory. Perturbation methods. Collision. Quantization of radiation. Applications chosen from atomic, laser, and solid state physics. Other applications may also be considered depending on the interest of the students. Prior familiarity with elementary quantum concepts is assumed. Prerequisite: permission of instructor.

80-445 X-RAY DIFFRACTION AND CRYSTAL STRUCTURE**I,II(2,3)3**

Elementary crystal structure. Generation and production of X-rays. Diffraction of X-rays by crystals. Elementary theory of scattering from electrons and atoms. Analytical methods: Laue patterns, rotation and oscillation patterns, powder pattern. Cameras and diffractometers. Applications to metallurgical and solid state problems. Lectures will be supplemented by laboratory work. Open to students from other departments, by permission of the instructor.

80-447,448 LASERS AND MASERS**I,II(3,0)3**

Introductory treatment of lasers, masers, and their applications, interaction of radiation with matter including electric and magnetic dipole transitions. The concept of stimulated emission. Rate equations. Optical resonators. Collision and line broadening processes. Study of various gaseous and solid state lasers and masers. Applications to harmonic generation, holography, and optical modulation techniques. Prerequisite: 95-335 or equivalent.

80-455 PLASMA PHYSICS**II,II(3,0)3**

An introduction to the field of plasma physics and its applications. Hydrodynamic equations. The Boltzmann equation. Motion of charged particles in electric and magnetic fields. Propagation of electromagnetic waves in plasma. Collision and radiation processes. Longitudinal oscillations of electrons and ions. Transport processes. Instabilities. Topics from solid state plasmas. Applications. Corequisites: 95-310, 95-421.

80-457 PHYSICAL ELECTRONICS**I,II(3,0)3**

Elements of quantum mechanics. Statistics. Electron emission from solids. Vacuum devices and gaseous processes. Semiconductors and their devices: diodes and transistors. Electron beams: the klystron. Modern amplifiers; the maser, the laser, and magnetron. Noise. Corequisite: 95-335.

80-463 MODERN PHYSICS FOR ENGINEERS I**I, (3,0)3**

Special relativity, electron properties, the quantum nature of light, the Rutherford atom, the Bohr model, many-electron atoms, molecular spectra and specific heats, x-rays and crystal diffraction, wave-particle duality, the Schrodinger equation, band theory of solids, insulators and semiconductors, magnetic properties of matter. Prerequisites: 95-245, or 95-146 calculus and ordinary differential equations.

80-464 MODERN PHYSICS FOR ENGINEERS II**II(3,0)3**

Nucleons and properties of nuclei, nuclear models, nuclear stability, radioactive α and β -decay, fission, the Q-equation and reaction kinematics, nuclear cross sections, reaction models and simple scattering theory, interactions of radiation with matter, nuclear reactors, controlled fusion. Prerequisite: 80-463.

80-499 COMPUTER METHODS AND NUMERICAL ANALYSIS**I(3,0)3**

Computer methods in the solution of engineering and physics problems using numerical analysis techniques. Topics include: error analysis, solution of algebraic, transcendental and polynomial equations, quadrature formulas for numerical integration, systems of linear equations, matrix manipulation, interpolation techniques, numerical differentiation, solution of differential equations, and curve fitting using linear and nonlinear least square methods.

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

80-586 SEMICONDUCTORS**I,II(3,0)3**

Transport and optical properties of semiconductors. Statistics, collision mechanisms, and band structure. Hot electrons. High magnetic field phenomenon. Devices: junctions and transistors; Gunn oscillators; semiconductor lasers. Prerequisite: permission of instructor.

Physics — Primarily Lecture Courses (Course Prefix: 95)

95-103 GENERAL PHYSICS I

I(3,0)3

The first semester of a year course which surveys the field of physics for students with major outside the College of Pure and Applied Science. Topics include force and motion, vectors, gravity, energy and momentum, heat and thermodynamics, and oscillations. Corequisite: 96-103.

95-104 GENERAL PHYSICS II

II(3,0)3

A continuation of General Physics I. Topics include waves, light, sound, electricity, magnetism, the atom, and the nucleus. Prerequisite: 95-103. Corequisite: 96-104.

95-141 PHYSICS I

I,II(3,0)3

First semester of a sequence for science and engineering majors. Vectors, kinematics in one and two dimensions, dynamics, work and energy, conservation of energy, center of mass, momentum, conservation of momentum, collisions. Corequisite: 96-141.

95-144 PHYSICS II

II(4,0)3

Rotational kinematics, rotational dynamics and angular momentum, statics, oscillations, fluid mechanics, wave motion and wave phenomena. Optics, including reflection, refraction, geometrical optics, interference and diffraction. Thermodynamics, including temperature, heat, heat capacity, ideal gas, first and second laws of thermodynamics. Prerequisites: 95-141, 92-131 or 92-133. Corequisite: 96-144.

95-145 FOUNDATIONS OF PHYSICS I

I,II(4,0)4

This is the first semester of a two-semester calculus-based sequence designed primarily for engineering majors and others who want an intensive analytical introductory course in physics. It includes the standard topics in vectors, statics, linear and planar kinematics and dynamics, the conservation principles, fluids, heat and thermodynamics, waves and oscillations. Corequisites: 96-145 and 92-131, 92-133, or 92-135.

95-146 FOUNDATIONS OF PHYSICS II

II, I(4,0)4

This is the second semester of a two-semester calculus-based sequence designed primarily for engineering majors and others who want an intensive analytical introductory course in physics. It includes topics in electricity and magnetism and in geometrical and physical optics. Prerequisite: 95-145. Corequisite: 96-146 and 92-132 or 92-134.

96-147 HONORS PHYSICS I

I(4,0)4

Introductory physics at a more challenging level, commencing with elementary mechanics; fundamental units and dimensions; vector treatment of forces and velocities; statics; equilibrium; kinematics of uniform and accelerated linear motion in one and two dimensions; Newton's laws of motion; friction; relativistic motion and frames of reference; dynamics—impulse, momentum, work, energy and power, conservation and invariance principles; motion of interacting systems; rotational motion—kinematics and dynamics; rotational angular momentum and energy; radial and tangential forces and acceleration; motion of gyroscopes and planets, laws of planetary motion. Corequisite: 96-147.

95-148 HONORS PHYSICS

II(4,0)4

Gravitation elasticity; fluid mechanics; simple harmonic motion; wave motion; Temperature and heat; ideal gas behavior; kinetic theory; heat; thermometry and calorimetry; thermal properties of matter; thermodynamics and statistical mechanics; radiation and quantum concepts; applications of quantum theory to quantum systems; atoms, molecules, nuclei and particles. Prerequisites: 95-147 and 92-133. Corequisite: 96-148.

95-149 SURVEY OF PHYSICS

I(3,0)3

An introduction to the topics of physics including: forces, work and energy, motion, conservation laws, electricity, magnetism and waves. For business majors only.

95-151 ELEMENTS OF PHYSICS

II(3,0)3

An introduction of the optics of physics including: force, work and energy, motion, conservation laws, electricity, magnetism and waves. For industrial technology majors only. Corequisite: 96-151.

95-201 PRINCIPLES OF PHYSICS I

I(3,0)3

An introduction to physics for students with majors other than physics in the College of Pure and Applied Science. Topics include Newtonian and relativistic mechanics in one and two dimensions, harmonic oscillators and

waves, calorimetry, heat transfer, and thermodynamics. Prerequisite: 1 year of college calculus. Corequisite: 96-201.

95-202 PRINCIPLES OF PHYSICS II

II(3,0)3

A continuation of Principles of Physics I(q.v.). Topics include geometric and physical optics, electricity and magnetism, and atomic and nuclear physics. Prerequisite: 95-201. Corequisite: 96-202.

95-209 ELECTRICITY AND MAGNETISM

I(4,0)4

Electrostatics: electric charge, Coulomb's law, electric field, Gauss' law, electric potential, capacitance, and dielectrics; electrodynamics; electric current, resistance, Ohm's law, resistivity, electromotive force, d-circuits, magnetic field, magnetic dipole moment, Biot-Savart law, Ampere's law, Faraday's law, inductance, and Maxwell's equations. Prerequisite: 95-144 or 95-148.

95-210 INTRODUCTORY MODERN PHYSICS

II(4,0)4

Special theory of relativity: Galilean transformation, nature and propagation of light, Einstein's postulates and assumptions, Lorentz transformation, simultaneity, time dilation, space contraction, velocity transformation, four vectors, proper time, Newton's second law of motion, conservation laws, center of mass, and collision problems. The electron: Millikan's experiment. Quantum nature of light: the Compton effect and the photoelectric effect. Matter waves. Davisson-Germer experiment. Wave-particle duality and the Uncertainty Principle. Prerequisite: 95-209.

95-218 PHYSICS OF SOUND AND MUSIC

II(3,0)3

A course designed for students with majors in the College of Music or in other colleges outside the College of Pure and Applied Science. Strings, woodwinds, and brasses are examined in terms of the principles of physics. The basic principles are presented in a relatively non-mathematical manner, and extensive use of demonstrations is made to aid in understanding the concepts. Fundamental concepts such as displacement, time, velocity, acceleration, force, energy, resonance, and waves are presented and related to the various instruments. Wave shapes and spectral energy distribution are examined for representative instruments. The acoustic properties of the ear and of rooms are also discussed.

95-235 MODERN PHYSICS FOR ENGINEERS

I(3,0)3

An introduction to selected topics in modern physics with an emphasis on those topics which have greater application in engineering. Topics may include kinetic theory, quantization, electron waves, the Schroedinger equation, atomic and molecular physics, and solid state. Prerequisites: 95-146 or 94-245 and 92-132 or 92-134.

95-245 PHYSICS III

I(4,0)3

Electric charge, Coulomb's law, electric field, Gauss' law, electric potential, capacitance; D.C. current Ohm's law, Joule effect, electromotive force, Kirchoff's rules, simple D.C. Circuits; magnetic field, current loops, Ampere's law, Faraday's law, electromagnetic induction; quantum theory; photoelectric effect, de Broglie waves, Bohr atom, atomic spectra. Prerequisites: 95-144, 92-132 or 92-134. Corequisite: 96-245.

95-283 INTRODUCTION TO THE THEORY OF RELATIVITY

I(2,0)2

Galilean transformation, Lorentz transformation, simultaneity; velocity and acceleration transformations, relativistic energy, four-vectors.

95-291 MODERN PHYSICS FOR HUMANISTS

I, II(3,0)3

A course which covers the developments in physics of the 20th Century that have influenced human thought and values. The universal symmetries, relativity and quantum mechanics will be examined in depth by exploring the processes of reasoning and investigation that led to the discoveries, and a connection sought between modern physical thinking and events of the current scene. No previous physics or mathematics background is required but an interest in logic and philosophy is desirable.

95-310 ELECTRICITY AND MAGNETISM II

II(4,0)4

Review of the fundamentals of electricity and magnetism, Maxwell's equations in differential form, Plane-wave solutions, polarization, Poynting vector and the flow of energy, radiation pressure, radiation from an accelerated charge, radiation from antennas, Bremstrahlung, cyclotron and synchrotron radiation, blackbody radiation, electric and magnetic fields near the surface of a conductor, waveguides, Maxwell's macroscopic equations, propagation of waves in dielectrics, conductors and plasmas, reflection, refraction, scattering, interference and diffraction of electromagnetic waves. Prerequisites: 92-208 and 95-209.

- 95-313 MECHANICS** I(4,0)4
Kinematics of a single particle, analysis of Newton's laws of motion, mechanics of a single particle in one and in more than one dimension, conservative and non-conservative forces, the linear oscillator, forced oscillations and resonance, central force motion, the Kepler problem, the two-body problem, coupled oscillators, systems of particles, rotation of rigid bodies, moments and products of inertia, Euler's angles, the symmetrical top. Prerequisite: 92-208.
- 95-335 INTRODUCTORY QUANTUM MECHANICS I** I(3,0)3
De Broglie waves, the Schrodinger equation, wave functions, wave packets, Heisenberg uncertainty principle, expectation values, particle in a box, the simple harmonic oscillator, free particles, step barrier, barrier penetration, square well potential, time independent perturbation theory. Prerequisite: 95-210.
- 95-336 INTRODUCTORY QUANTUM MECHANICS II** II(3,0)3
The three dimensional Schrodinger equation, the deuteron nucleus, angular momentum, spin, the hydrogen atom, spin-orbit interaction, Zeeman effect, Pauli exclusion principle, atomic structure, multi-electron atoms, the Fermi gas, X-rays. Prerequisite: 95-335.
- 95-338 PHYSICAL OPTICS** II(3,0)3
Wave nature of light, mathematics of wave motion, electromagnetic theory of light propagation, reflection and refraction, Fresnel coefficients, polarization, interference, Young's experiment, fringe visibility and coherence, various interferometers, Newton's rings and applications, Fraunhofer diffraction by single and multiple apertures and diffraction gratings. Prerequisite: 95-209.
- 95-353 ELECTROMAGNETISM I** I(3,0)3
The theory of electromagnetic fields using vector analysis: electrostatic fields and potentials in vacuum, conductors, and dielectric media; electric multipoles; solutions to Laplace's equation; boundary conditions; image charge problems; magnetic effects of steady currents in nonmagnetic media. Prerequisites: 92-208, 95-210.
- 95-354 ELECTROMAGNETISM II** II(3,0)3
Magnetic induction and time varying currents and fields; magnetic materials; Maxwell's equations; propagation of electromagnetic waves in vacuum, conductors and dielectrics; reflection and refraction of electromagnetic waves; radiation from accelerating charges and antennas. Prerequisite: 95-353.
- 95-385 ASTRONOMY AND ASTROPHYSICS I** I(3,0)3
This course is designed for an interdisciplinary general undergraduate (upperclassmen) audience. Fundamentals of astronomy and astromechanics, introductory survey of astrophysics and the solar system (i.e., planetary astronomy).
- 95-386 ASTRONOMY AND ASTROPHYSICS II** II(3,0)3
Continuation of 95-385. Sun as a star, stellar and galactic astronomy, and cosmology.
- 95-421 STATISTICAL THERMODYNAMICS** I(4,0)4
An integrated study of the thermodynamics and statistical mechanics, review of the experimental foundations and historical development of classical thermodynamics; probability and statistical methods of studying macroscopic systems; atomic basis of the laws of thermodynamics and microscopic definitions of thermodynamics quantities using the method of ensembles: entropy and related quantities; TdS equations, Maxwell relations, equation of state, and applications: canonical and grand canonical ensembles; phase transitions; quantum statistics; application to radiation, magnetism, specific heats. Prerequisite: 95-336.
- 95-461 TOPICS IN NUCLEAR PHYSICS** I(3,0)3
This course is designed to familiarize the student with a few research areas in the field of nuclear physics. The topics covered may vary from year to year. They will be chosen from the following list: nuclear constituents, fundamentals of interaction forces, liquid drop model and stability energetics, cross sections, passage of ionizing radiations through matter, alpha-decay, beta-decay and electron capture, gamma-decay and internal conversion, nuclear reaction systematics, fission and fusion, models of nuclear structure, and reaction mechanisms. Prerequisite: 95-336.
- 95-472 TOPICS IN SOLID STATE PHYSICS** II(3,0)3
Crystal structures, X-ray and neutron diffraction, lattice vibrations, the free electron and the band models of metals, semiconductors and application, dielectric and optical properties of solids, magnetism, and superconductivity. Prerequisite: 95-421.

95-497 BIOPHYSICS SEMINAR I**I(2,0)1**

A seminar type course with the students leading discussions on almost any topic of physical interest in biology, but with emphasis on the following: the living cell, its structure and function, how it moves, divides and transforms energy, enzymes, the structure of proteins and nucleic acids, the DNA and RNA molecules, the gene and the genetic code.

95-498 BIOPHYSICS SEMINAR II**II(2,0)1**

A continuation of 95-497; the mechanism of muscle contraction, the electrical nature of cells, the nerve impulse, biological transducers, the ear, the eye, brain waves, psychophysics, artificial "life", and the origin and evolution of living systems.

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of instructor.

95-505, 506 MATHEMATICAL METHODS OF PHYSICS I-II**I(4,0)4; II(4,0)4**

Vector and Cartesian tensor analysis; matrices and determinants; partial differential equations, boundary value problems, and special functions. Numerical analysis and applications; theory of analytic functions; Green's functions. Prerequisite: permission of instructor.

95-507 HIGH-ENERGY PHYSICS**I,II(3,0)3**

A survey designed for the nonspecialist. Elements of relativistic scattering theory, the quantum numbers and conservation laws of high-energy physics, strong and weak interactions, dispersion relations. Regge poles and unitary symmetry. Prerequisite: 95-516.

95-511 CLASSICAL MECHANICS**I(3,0)3**

Lagrangian formulation (including Lagrange Multipliers), the Kepler problem and Rutherford scattering; rotating coordinate systems and rigid body motion; small oscillations and stability problems Hamiltonian formulation. Prerequisite: permission of instructor.

95-513 MECHANICS**I(4,0)4**

Kinematics of a single particle, analysis of Newton's laws of motion, mechanics of a single particle in one and in more than one dimension, conservative and non-conservative forces, the linear oscillator, forced oscillations and resonance, central force motion, kinematics and elastic collisions in two particle systems, mechanics of particles, generalized coordinates, Lagrange's equations, the Hamiltonian function. Prerequisite: 92-208.

95-515,516 QUANTUM MECHANICS I-II**I(3,0)3; II(3,0)3**

Wave packets and free particle motion, the wave function and the Schroedinger equation, the linear harmonic oscillator, the WKB approximation, central forces and angular momentum, spin, and time-dependent and independent perturbation theory. Scattering theory. Corequisite: 95-511.

95-517, 518 ADVANCED QUANTUM MATHEMATICS I-II**I(3,0)3; II(3,0)3**

The formal theory of scattering, Klein-Gordon and Dirac equations and simple applications; quantum theory of radiation. Symmetry principles and elements of groups theory; introduction to many-body theory; Hartree-Fock self-consistent calculations and their applications to atomic, solid state, and nuclear physics. Prerequisite: 95-516.

95-522 STATISTICAL MECHANICS**(3,0)3**

The classical statistical mechanics of Gibbs and Darwin-Fowler, the quantum statistical mechanics of Fermi, Dirac, and Bose-Einstein, and applications to thermodynamics, solid-state physics, and nuclear physics. Prerequisite: permission of instructor.

95-535 INTRODUCTORY QUANTUM MECHANICS I**I(3,0)3**

De Broglie waves, the Schroedinger equation, wave functions, wave packets, Heisenberg uncertainty principle, expectation values, particle in a box, the simple harmonic oscillator, free particles, step barrier, barrier penetration, square well potential. Prerequisite: 95-210.

95-536 INTRODUCTORY QUANTUM MECHANICS II**II(3,0)3**

The three dimensional Schroedinger equation, the deuteron nucleus; angular momentum, spin, the hydrogen atom, spin-orbit interaction, Zeeman effect, Pauli exclusion principle, atomic structure, spectroscopic nomenclature, and molecular structure. Prerequisite: 95-335.

- 95-553 ELECTROMAGNETISM I I(3,0)3
The theory of electromagnetic fields using vector analysis and Maxwell's equations; static electric and magnetic fields in conductors and dielectrics, scalar and vector potentials, solutions to Laplace's equation, image charge problems, and energy density problems. Prerequisite: 92-208, 95-210.
- 95-554 ELECTROMAGNETISM II I(3,0)3
Time-varying electromagnetic fields, ferromagnetic materials, propagation of plane waves in conductors and dielectrics, Snell's law, Fresnel equations, polarization, and radiation from accelerated charges and antennas. Prerequisite: 95-553.
- 95-558, 559 ELECTROMAGNETIC THEORY I-II I(4,0)4; II(4,0)4
Electrostatics and magnetostatics with special attention to boundary value problems. Quasistatic fields and displacement currents. Maxwell's equations, the Special Theory of Relativity, Waveguides, Mie scattering, radiation from an accelerated charge; plasma physics. Prerequisite: permission of instructor. Corequisite: 95-505/506.
- 95-560 APPLIED QUANTUM MECHANICS I,II(3,0)3
Relativistic Dirac equation of the electron and its simple applications. Symmetry principles in quantum mechanics and elements of group theory. Introduction to many body theory. Hartree-Fock self-consistent calculations, and their applications to the theory of many electron atoms, and the nuclei of atoms. Emission and absorption of radiation by quantum systems such as atoms and nuclei. Widths and intensities of spectral lines. Selection rules. Electric and magnetic multipole moments of nuclei and e.m. transition probabilities for nuclei. Prerequisite: 95-515/516.
- 95-561, 562 NUCLEAR PHYSICS I-II I(3,0)3; II(3,0)3
Stationary states of nuclei, nuclear charge radius, mass, moments, parity, and statistics; theory of alpha, beta, and gamma decay; fission reactions, induced by charged particles, gamma rays, and neutrons; nuclear forces and nuclear models; and fast neutron physics. Prerequisite: permission of instructor.
- 95-573 ADVANCED THEORY OF SOLIDS I I(3,0)3
Lattice vibrations and their interactions with X-rays, neutrons and light. The band model of solids and energy calculations. The Fermi surface. Transport and optical properties in metals and semiconductors. Prerequisite: 95-516 and permission of instructor.
- 95-574 ADVANCED THEORY OF SOLIDS II II(3,0)3
Magnetism and magnetic resonance. Superconductivity. Many body theory and its applications. Collective excitations. Green function techniques in solid state physics. Prerequisite: 95-573.
- 95-575, 576 NEUTRAL PARTICLE TRANSPORT I-II I(3,0)3; II(3,0)3
Boltzmann and integral transport equations. Spherical harmonic and variational methods. Corrections to diffusion theory. Special methods of solving transport equations. Adjoint functions. Applications. Prerequisite: permission of instructor.
- 95-581, 582 THEORY OF NOISE AND RANDOM PROCESSES I-II I(3,0)3; II(3,0)3
Probabilities. Statistical analysis of random processes. Ensemble theory. Signals and noise in nonlinear systems. Information theory. Normally distributed random processes. Langevin. Fokker-Planck and Boltzmann equations. Thermal, shot and impulse noise. Linear measurements, prediction, and optimum filtering. A strong background in applied mathematics is required. Some knowledge of AC circuit theory and electronics would also be useful. Prerequisite: 95-505/506. 95-521, 522 (May be taken concurrently)
- 95-583, 584 GENERAL THEORY OF RELATIVITY I-II I(3,0)3; II(3,0)3
Review of Newtonian gravitational theory and special relativity. The weak and strong principles of equivalence. Tensor analysis in Riemann spaces. Einstein's equations for the gravitational field. Classic tests of Einstein's theory; spherically symmetric solutions. Gravitational field theory and the canonical analysis of general relativity. Prerequisite: knowledge of special relativity including tensor notation.
- 95-593, 594 GRADUATE LABORATORY (0-9) (0-9)6
A laboratory course designed to acquaint the graduate student with the methods of techniques of modern experimental physics.

Primarily Laboratory Courses (Course Prefix: 96)

- 96-103 GENERAL EXPERIMENTAL PHYSICS I** I(1,2)1
The first semester of a year course which surveys the field of experimental physics for students with majors outside the College of Pure and Applied Science. Corequisite: 95-103.
- 96-104 GENERAL EXPERIMENTAL PHYSICS II** II(2,1)1
A continuation of General Experimental Physics I with topics correlated with General Physics II. Prerequisite: 96-103. Corequisite: 95-104.
- 96-141 FUNDAMENTALS OF EXPERIMENTAL PHYSICS I** I,II(.5,1)1
An introductory course on the methods and techniques of experimental physics. Experiments are selected principally in the areas of statics and kinematics. Corequisite: 95-141.
- 96-144 FUNDAMENTALS OF EXPERIMENTAL PHYSICS II** II(.5,1)1
A continuation of 96-141 with experiments principally in mechanics, waves, optics and thermodynamics. Prerequisite: 95-141. Corequisite: 95-142 or 95-144.
- 96-145 FOUNDATIONS OF EXPERIMENTAL PHYSICS I** I,II(0.5,1)1
An introductory course in the methods and techniques of experimental physics with experiments selected principally in the area of mechanics. Corequisite: 95-145.
- 96-146 FOUNDATIONS OF EXPERIMENTAL PHYSICS II** II(0.5,1)1
A continuation of 96-145 with experiments principally in optics and electricity and magnetism. Prerequisite: 96-145. Corequisite: 95-146.
- 96-147 FUNDAMENTALS OF EXPERIMENTAL PHYSICS I HONORS** I(.5,1.5)1
An introductory course at the honors level on the methods and techniques of experimental physics. Lectures on measurement uncertainties and error analysis are included and experiments are selected principally in the areas of statics and kinematics. Corequisite: 95-147.
- 96-148 FUNDAMENTALS OF EXPERIMENTAL PHYSICS II HONORS** II(1,2)1
A continuation of 96-147 with experiments selected principally from mechanics, waves, optics and thermodynamics. Students are introduced to more advanced measurement techniques and instrumentation than in 96-144. Prerequisite: 96-147. Corequisite: 95-148.
- 96-151 ELEMENTS OF EXPERIMENTAL PHYSICS** II(3,0)1
This course is for Industrial Technology majors and introduces the student to basic experimental techniques in physics with applications principally in the areas of mechanics and electricity. Corequisite: 95-151.
- 96-201 PRINCIPLES OF EXPERIMENTAL PHYSICS I** I(1,2)1
An introduction to experimental physics for students with majors other than physics in the College of Pure and Applied Science. Topics include measurement and error, mechanics, waves, and heat. Corequisite: 95-201.
- 96-202 PRINCIPLES OF EXPERIMENTAL PHYSICS II** II(1,2)1
A continuation of Principles of Experimental Physics I(q.v.) Topics include optics, electricity and magnetism, spectroscopy, radioactivity, and statistical analysis. Prerequisite: 96-201. Corequisite: 95-202.
- 96-245 FUNDAMENTALS OF EXPERIMENTAL PHYSICS III** I(.5,1)1
Experimental methods and techniques in physics with applications to the areas of electricity and magnetism. Topics include the measurement of electric and potential fields. RC decay, bridge networks, magnetic fields and the motion of charged particles. Prerequisite: 96-144. Corequisite: 95-243 or 95-245.
- 96-257 PHYSICAL INSTRUMENTATION** I(1,3)2
An introduction to measurement devices emphasizing practical physical applications. Both analog and digital electronic techniques are covered. Corequisite: 95-209 or equivalent.
- 96-293 EXPERIMENTAL PHYSICS I** I(1,6)3
A course in experimental physics, with related theoretical material. Experiments are principally in the area of electrical measurements. Lectures are given on laboratory techniques and practices, and on the elementary theory of errors. The laboratory and lectures are integrated. Prerequisite: 95-144 or 95-148.

- 96-294 EXPERIMENTAL PHYSICS II II(1,6)3
Continuations of 96-293. Experiments are principally in the areas of optics, thermodynamics, mechanics and atomic and nuclear physics.
- 96-337 GEOMETRICAL OPTICS LABORATORY I(0,6)2
Experiments in physical optics covering the following topics: reflection, refraction, index of refraction, thin and thick lenses, single optical surfaces, mirrors, prisms, films, aberrations, alignment, telescope, periscope, endoscope and stops. Corequisite: 80-337; or permission of the instructor.
- 96-338 PHYSICAL OPTICS LABORATORY II(0,6)2
Experiments in physical optics covering the following topics: Michelson and Twyman-Green interferometers, Newton's rings, optical testing, multiple beam interference, diffraction grating, spectroscopy, Fresnel and Fraunhofer diffraction, reflection of light from a dielectric surface, polarization, holography. Prerequisite: 96-337, Corequisite: 80-338 or permission of the instructor.
- 96-393 INTERMEDIATE PHYSICS LABORATORY I I(0,6)2
Advanced experiments in various branches of physics including optics and atomic physics. Prerequisite: 96-294.
- 96-394 INTERMEDIATE PHYSICS LABORATORY II II(0,6)2
Advanced experiments in various branches of physics including solid state physics and nuclear physics, with opportunities for independent work by permission of the instructor.
- 96-439 SOURCES AND DETECTORS IN MODERN OPTICS LABORATORY I(0,6)2
Advanced experiments in optics covering the following topics: detectivity of a detector, absorption and reflection spectroscopy (VIS, IR), optical coatings, detector characteristics, blackbody radiation, photometry, crystal optics, optical properties of thin films, laser modes and sources of noise in detector systems. Prerequisites: 96-337, 96-338, Corequisite: 80-439; or permission of the instructor.
- 96-440 IMAGING SYSTEMS AND IMAGE PROCESSING LABORATORY II(0,6)2
Advanced experiments in optics covering the following topics: image processing facilities, photographic imaging, image properties, image enhancement, Fourier analysis — spatial filtering (optical), Fourier transforms of images and spatial filtering (digital), feature detection and pattern recognition. A short independent project in an area of image processing and pattern recognition. Prerequisites: 96-337, 96-338, Corequisite: 80-440; or permission of the instructor.
- 96-495 SPECIAL RESEARCH PROBLEMS I I(3,0)3
Special problems in physics assigned to the individual student with emphasis on modern research methods and preparation of results for publication. Prerequisite: permission of department chairperson and instructor.
- 96-496 SPECIAL RESEARCH PROBLEMS II II(3,0)3
A continuation of 95-495 for a second semester. Prerequisite: permission of department chairperson and instructor.

Primarily for Graduate Students

Graduate courses are open to undergraduates with the permission of the instructor.

- 96-509 PHYSICS PRACTICUM I I(1,1)1
Through observation, and presentation of demonstrations and experiments, the student becomes familiar with instructional techniques in experimental physics. Prerequisite: permission of the instructor.
- 96-510 PHYSICS PRACTICUM II II(1,1)1
A continuation of 96-509.
- 96-593, 594 GRADUATE LABORATORY I-II I(0,9)3; II(0,9)3
A laboratory course designed to acquaint the graduate student with the methods and techniques of modern experimental physics. Prerequisite: permission of the instructor.

Radiological Health Physics (Course Prefix: 98)

98-101 INTRODUCTION TO RADIOLOGICAL SCIENCES

I(0,3)1

Introduction to atomic and nuclear physics; natural and artificial radio-activity, radiation, decay schemes; nuclear reactions including fission and fusion; interaction of radiation with matter; radiation quantities and units; shielding; biological effects of radiation; radiation protection standards and regulations.

98-102 INTRODUCTION TO RADIOLOGICAL SCIENCES

II(0,3)1

Principles of radiation detection and detection devices; counting systems and assay of α , β , γ , emitters; survey and monitoring equipment; external radiation exposure and protection techniques; radiation safety and control; accelerator and reactor health physics; medical radiation physics and X-ray protection.

98-201 HEALTH PHYSICS INTERNSHIP I

I,II(0,10)3

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Prerequisites: radiological health physics major; 98-101 and 98-102; approval department chairperson.

98-202 HEALTH PHYSICS INTERNSHIP I

I,II(0,10)3

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Prerequisites: radiological health physics majors; 98-201; approval department chairperson.

98-301 HEALTH PHYSICS INTERNSHIP II

I,II(0,10)3

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital or education and research institution. Students in this course will be given increased responsibilities commensurate with prior experience. Prerequisites: radiological health physics major; 98-201 and 98-202, approval department chairperson.

98-302 HEALTH PHYSICS INTERNSHIP II

I,II(0,10)3

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Students in this course will be given increased responsibilities commensurate with prior experience. Prerequisites: radiological health physics major; 98-202; approval department chairperson.

98-401 PRINCIPLES OF RADIATION SAFETY AND CONTROL

I(3,0)3

Introduction to radiation protection, including radiation sources, radiation dose and dose measurement, radiation exposure, radiation protection techniques, monitoring methods and instruments, contamination control and waste storage, facility design, hazards analysis, and applied health physics techniques for the safe handling and control of radioactive material including laboratory. Prerequisite: 80-202 or equivalent.

98-402 PRINCIPLES OF RADIATION SAFETY AND CONTROL

II(3,3)4

A laboratory course giving students experience with equipment and practices of current use in the radiation protection field, an extension of 98-401 giving some of the practical aspects of radiation safety and control. Prerequisite: 98-401.

98-412 RESEARCH IN RADIOLOGICAL SCIENCES

I(0,10)3

A research problem related to the field of radiation protection is investigated by the student under the direction of faculty and staff of the Nuclear Center. The student will present a seminar on his research project. Areas of research anticipated include radiation shielding, radiation detection and measurement, radiation survey and monitoring, radiation biology, radiation chemistry, radiobiology, radiochemistry, radioecology, natural radioactivity, fall out, analyses and measurement of radioactivity and radiation levels associated with the operation of reactors and accelerators, and radioactive aerosols. Prerequisites: senior status as radiological health physics major and approved proposal.

98-422 ENVIRONMENTAL RADIATION AND NUCLEAR SITE CRITERIA

II(3,0)3

Sources of radioactive waste and waste treatment; internal dosimetry, maximum permissible concentrations, distribution of radioactivity in the environment and the significance of releases to the air, aquatic and terrestrial ecosystems; design and operation of environmental surveillance programs around nuclear facilities; reactor site criteria, licensing, regulations, credible accidents, meteorological considerations, normal and abnormal operations, environmental impact of nuclear reactors. Prerequisite: 98-401 or equivalent.

- 98-441 RADIOISOTOPE TECHNIQUES I(3,0)3
A course for students and staff designed to acquaint them with the theory and use of radioisotopes and the principles and operation of radiation counting systems. Lecture sessions are topics related to biological effects of radiation exposure, safe use of radiation sources, radiation protection techniques and procedures, and design of radiation facilities. Prerequisite: senior status as biology major or equivalent background.
- 98-443 RADIOISOTOPE TECHNIQUES LABORATORY I I(0,3)1
Laboratory experience in tracer techniques and appropriate use of various types of laboratory counting instruments. Corequisite: 98-141 or equivalent.
- 98-451 INTRODUCTION TO ELECTRONIC PRODUCT RADIATION I(3,0)3
The theoretical and applied aspects of the generation, measurement, and uses of radiant energy from electronic products whose emissions span the entire electromagnetic spectrum; ultrasonic energy emitted by electronic products; biological effects, standards of protection and control, and consequences and intent of Public Law 90-602. Prerequisite: 98-401.
- 98-461 SPECIAL TOPICS IN RADIOLOGICAL SCIENCES I(3,0)3
This course is used to provide students with current information on a variety of current topics. Topics covered are announced prior to registration. Topics may vary from year to year. Prerequisite: senior status as radiological health physics major.
- 98-462 SPECIAL TOPICS IN RADIOLOGICAL SCIENCES II(3,0)3
This course is used to provide students with current information on a variety of current topics. Topics covered are announced prior to registration. Topics may vary from year to year. Prerequisite: senior status as radiological health physics major.
- 98-472 RADIATION BIOLOGY II(3,0)3
A study of the interactions of radiations with living systems. The effects of ionizing radiation of the molecular, cellular and organismic levels. The acute and latent effects in whole animals and the modification of radiation exposure by physical, chemical and biological factors. Prerequisites: 81-252, 98-441 or equivalent.

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

- 98-505 RADIATION DOSIMETRY (3-0)3
Sources of radiation exposure; calculations of chronic and acute radiation doses and their effects; internal dosimetry including distribution and elimination of radioisotopes; alpha, beta, gamma, and neutron dosimetry; principles of charge measurement and energy transfer; use and calibration of instruments including solid state dosimeters, ion chambers, and extrapolation chambers.
- 98-507 RADIATION DOSIMETRY LABORATORY (0,3)1
Laboratory experience coordinated with lecture sequence in 98-505. Corequisite: 98-505.
- 98-508 ENVIRONMENTAL TOXICOLOGY AND EPIDEMIOLOGY (3,0)3
Study of the systems of the body with respect to the sites and modes of action by various toxic agents. Discussion of procedures for evaluation of toxicity of radioactive and non-radioactive agents. Determination of TLV and LD50 values. Review of status of current epidemiology studies of effects of radiation and other toxic agents. Discussion of occupational environments with respect to standards, control measures, and current problems. Review of standards for protection of the environment and the general public. Offered in odd-numbered years. Prerequisite: permission of instructor.
- 98-510 ENVIRONMENTAL TOXICOLOGY LABORATORY (0-3)1
Laboratory experiments on the effects of toxic agents on plant and animal systems with emphasis on radiation and air pollution. (Offered odd-numbered years). Corequisite: 95-508.
- 98-513 ENVIRONMENTAL MONITORING AND SURVEILLANCE (3,0)3
Sources and types of natural and man-made environmental radioactivity; meteorological, hydrological and ecological considerations in the transport of radionuclides released to the environment, ecological pathways important in the consideration and estimation of resulting doses or in the selection of environmental sampling

media; objectives and design of pre-operational, operational and emergency monitoring programs; sampling and analysis programs for specific radionuclides and external radiation source; analytical equipment and procedures and limits of detection for specific radionuclides; design of an environmental laboratory and emergency monitoring vans for nuclear power stations. Prerequisite: 98-502.

98-514 EXTERNAL RADIATION DOSIMETRY

(3-3)4

Provides a review and gives state of the art information in this important area of radiation protection. Information presented is reinforced through laboratories demonstrations and problem solving sessions. Includes a review of radiation quantities and units; sources of external radiation exposure; calculation of receptor free radiation quantities for different geometry sources; beta, gamma, and neutron dosimetry; principles of charge measurement and energy transfer; use and calibration of instruments including solid state and film dosimeters, ion chambers, and extrapolation chambers; calibration sources; accident dosimetry; recommendations of standard setting organizations; and regulatory requirements.

98-515 INTERNAL RADIATION DOSIMETRY

(3-0)3

Provides a review and gives state of the art information in this important radiation protection area. Information presented is reinforced through demonstrations and problem solving sessions. Includes a review of the applicable physiological models for standard man; sources of internal radiation exposure; a comparison of the 1959 ICRP 2 and the 1978 ICRP 30 reports, recommendations and models; kinetics equations for calculating the instantaneous burden, atoms absorbed into the blood, excreta, and cumulated activities of parent and daughter radionuclides in various organs, tissues, and compartments in the body; calculation of specific absorbed energies, 50 year dose equivalent commitment and values weighted by cancer and hereditary disease risk, Annual Limit Intakes (ALI), and Derived Air Concentrations (DAC); guidance relative to the interpretation of body measurements and bioassay data in terms of investigation levels and appropriate actions at various levels; recommended frequency for body burden measurements and bioassays based upon minimum detectable activities, investigation levels, and potential for exposure; accident internal radiation dosimetry; recommendations of standard setting organizations; and regulatory requirements.

98-516 DATA REDUCTION FOR RADIOLOGICAL SCIENCES AND PROTECTION

(3-0)3

Provides the development and use of fundamental statistical concepts applicable to data reduction and error analyses. Concepts and relationships are reinforced by the presentation of applications in the field of radiological sciences and protection and through the solutions of many example problems. Concepts and applications presented in the course include: the fundamental statistical concepts of errors, means, variance, and standard deviations of parent and sample populations; permutations and combinations; integral, discrete and differential distribution functions including the binomial, Poisson, Gaussian, and Lorentzian distributions; applications of binomial discrete probability function and a general kinetics equation to the estimation of populations of radioactive atoms through sampling and counting experiments; propagation of errors; variance in sample, background and net counts and in counting rates; optimum distribution of background and sample counting intervals; optimum counting interval for estimation of population of atoms of a short lived radionuclide; minimum detectable activity and lower limit of detection of counting systems; chi square and other statistical tests of the operability of counting systems, tests of distributions, fitting functions, and a-priori assumption of population variance; correlation probability; estimation of parameter values of fitting functions by method of least squares; and χ^2 and F test of the goodness of fit.

98-522 ENVIRONMENTAL RADIATION AND NUCLEAR SITE CRITERIA

(3-0)3

Sources of radioactive waste and waste treatment, internal dosimetry, maximum permissible concentrations; distribution of radioactivity and the environment and the significance of releases to the air, aquatic and terrestrial ecosystems; design and operation of environmental surveillance programs around nuclear facilities; reactor site criteria, licensing, regulations, credible accidents, meteorological considerations, normal and abnormal operations, environmental impact of nuclear reactors. Prerequisite: 98-501 or equivalent.

98-532 INTRODUCTION TO NUCLEAR RADIATION SHIELDING

(3-0)3

Interaction of neutrons, gamma rays, and charged particles with matter, buildup factors; shielding of point, surface, and volume sources; shielding design factors in reactor and accelerator operation. Prerequisite: permission of instructor.

98-534 INTRODUCTION TO RADIATION SHIELDING LABORATORY

(0-3)1

Laboratory coordinated with 98-532 with applications to health physics problems. Prerequisite: 98-352.

98-551 INTRODUCTION TO ELECTRONIC PRODUCT RADIATION

(3-0)3

The theoretical and applied aspects of the generation, measurement, and uses of radiant energy from electronic products whose emissions span the entire electromagnetic spectrum; ultrasonic energy emitted by electronic products, biological effects, standards of protection and control, and consequences and intent of Public Law 90-602. Prerequisite: 98-501.

Radiological Health Physics — Courses for Non-Majors (Course Prefix: 99)

99-101/102 RADIATION & LIFE

I,II(3,0)3

An introduction to the field of radiological sciences, including discussions of benefits and risks of nuclear energy. Lectures, demonstrations and field trips. Recommended for non-science majors. May not be credited to radiological health physics majors. Alexander.

99-461/462 SPECIAL TOPICS IN RADIOLOGICAL SCIENCES

I,II(1-3,0)1-3

This course is used to provide non-major students with current information on a variety of topics in radiological sciences. Topics covered are announced prior to registration. May not be credited to radiological health physics major. Staff.

FACULTY OF THE COLLEGE OF PURE AND APPLIED SCIENCES

DEAN OF THE COLLEGE

Joseph Salamone, B.S., Ph.D.

ASSISTANT DEAN

F. Raymond Hardy, B.S., M.S.

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- Winship C. Fuller, Assistant Professor, Computer Science; Sc.B., Suffolk University; M.A., Ph.D., Tufts University.
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- Richard Z. Gore, Associate Professor, Earth Sciences; B.S., City College of New York; M.S., Boston College; Ph.D., Boston University.
- Michael Grossman, Associate Professor, Mathematics; B.S. Tufts University; M.A., Yale University.
- F. Raymond Hardy, Professor, Physics; B.S., M.S., Lowell Technological Institute.
- Padmanabh Harihar, Associate Professor, Physics; B.S., R. Ruia College (India); M.S., Wilson College (India); Ph.D., Columbia University.
- Jesse Y. Harris, Professor, Physics; B.S., M.S., Ph.D., Rutgers University.
- Don B. Hilton, Assistant Professor, Chemistry; A.B., Boston University; M.S., Northeastern University; Ph.D., University of Maine.
- Curtis P. Hineley, Assistant Professor, Biological Sciences; B.A., Yale University; Ed.M., Harvard University.
- Jerome Hohnacki, Associate Professor, Biological Sciences; B.S., Southern Connecticut College; M.S., University of Bridgeport; Ph.D., University of New Hampshire.
- Ann Marie Hurley, Assistant Professor, Mathematics; A.B., Emmanuel College.
- Martin Isaks, Associate Professor, Chemistry; B.S., Purdue University; M.S., Iowa State University; Ph.D., University of Cincinnati.
- Stanley C. Israel, Professor, Chemistry; B.S., Parsons College; Ph.D., Lowell Technological Institute.
- Ernest P. James, Professor, Chemistry; B.T.C., M.S., Lowell Technological Institute.
- Gerald Kaiser, Associate Professor, Mathematics; B.S., Case Institute of Technology; M.S., Carlton College; M.S., Ph.D., University of Wisconsin; Ph.D., University of Toronto.
- Ethel N. Kamien, Professor, Biological Sciences; B.A., Brooklyn College; M.S., Ph.D., University of Wisconsin.
- Lloyd C. Kannenberg, Professor, Physics; S.B., Massachusetts Institute of Technology; M.S., University of Florida; Ph.D., Northeastern University.
- Alan Kaplan, Assistant Professor, Mathematics; B.S., University of Massachusetts; M.S., Ph.D., Syracuse University.
- Aram S. Karakashian, Professor, Physics; B.A., M.A., Temple University; Ph.D., University of Maryland.
- Gunter H.R. Kegel, Professor, Physics; B.Ph., University of Brazil; Ph.D., Massachusetts Institute of Technology.
- Judith A. Kelley, Assistant Professor, Chemistry; B.A., Emmanuel College; M.S., Lowell Technological Institute.
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- David Korff, Professor, Computer Science; B.A.; Harvard; Ph.D., Brandeis University.
- Albert D. Kowalak, Associate Professor, Chemistry; B.S., College of William and Mary; M.S., Ph.D., Virginia Polytechnic Institute.
- Patrick D. Krolak, Professor, Computer Science; B.S., University of Chicago; M.A., D.Sc., Washington University.
- Thomas G. Kudzma, Assistant Professor, Mathematics; S.B., Massachusetts Institute of Technology; A.M., Harvard University.
- Phillip S. Lamprey, Professor, Chemistry; B.S., Lowell Technological Institute; Ph.D., University of New Hampshire.
- Robert J. Lechner, Professor, Computer Science; B.S., M.S., Carnegie-Mellon University; Ph.D., Harvard University.
- Sui-Lam Lee, Assistant Professor, Biological Sciences; B.Sc., Chung Chi College (Hong Kong); M.A., Oberlin College; Ph.D., Cornell University.
- Kenneth M. Levasseur, Assistant Professor, Mathematics; B.A., St. Anselm's College; M.S., Ph.D., University of Rhode Island.
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- Irving Lipschitz, Associate Professor, Chemistry; B.A., M.S., New York University; Ph.D., Virginia Polytechnic Institute.
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- Robert J. Peirant, Professor, Chemistry; B.S., M.S., Lowell Technological Institute.
- James B. Pierce, Professor, Chemistry; B.S., The College; M.S., Ph.D., Case Institute of Technology.
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- Myra Jean Priele, Assistant Professor, Computer Science; B.A., M.A., Hunter College; Ph.D., Rensselaer Institute of Technology.
- Paul N. Protopoulos, Associate Professor, Biological Sciences; B.S., Ed.M., M.S., Tufts University.
- David J. Pullen, Professor, Physics; B.Sc., London University; D. Phil., Oxford University.
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Alexander Sachs, Assistant Professor, Physics; B.S., Northwestern University.

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Samuel P. Sawan, Assistant Professor, Chemistry; B.S., Ph.D., University of Akron.

Allan Scattergood, Professor Emeritus, Chemistry; A.B., Columbia University; Ph.D., Princeton University.

Walter A. Schier, Professor, Physics; B.S., St. Procopius College; Ph.D., University of Notre Dame.

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Bernard Shapiro, Professor, Mathematics; B.S., Lowell Technological Institute; S.M., Massachusetts Institute of Technology.

Eric Sheldon, Professor, Physics; B.Sc., B.Sc., Ph.D., D.Sc., University of London.

Prentiss Shepherd, Jr., Assistant Professor, Biological Sciences; A.B., A.M., Harvard University.

John C. Sieg, Jr., Instructor, Computer Sciences; A.B., Dartmouth College; M.S., University of Lowell.

Ilze Skare, Associate Professor, Biological Sciences; B.A., University of Connecticut; Ph.D., Duke University.

Kenneth W. Skrable, Professor, Physics; B.S., Moravian College; M.S., Vanderbilt University; Ph.D., Rutgers University.

Barbara L. Smith, Assistant Professor, Chemistry; B.S., Lowell Technological Institute.

Malcolm K. Smith, Professor, Physics; B.S., Haverford College; M.A., Columbia University.

Stanley L. Spiegel, Assistant Professor, Mathematics; B.S., New York University; A.M., Ph.D., Harvard University.

Charles A. Steele, Jr., Assistant Professor, Computer Science, A.B., M.A., Boston College; M.S.E.E. Northeastern University.

Marvin E. Stick, Assistant Professor, Mathematics; B.S., Boston College; M.A., Boston University; Ph.D., Boston College.

Richard W. Stimits, Associate Professor, Physics; B.S., Ph.D., Massachusetts Institute of Technology.

Arthur D. Talkington, Associate Professor, Mathematics; B.S., University of Chicago; M.A., University of Missouri.

Wen Tang, Associate Professor, Earth Sciences; B.S., National Central University (China); M.S., Ph.D., New York University.

Ruth E. Tanner, Professor, Chemistry; B.S., Purdue University; Ph.D., University of Cincinnati.

Virginia S. Taylor, Professor, Mathematics; B.S. Syracuse University, M.A., Western Michigan University; Ph.D., Boston College.

Ye-Yung Teng, Associate Professor, Physics; B.S., National Taiwan University; M.S., Ph.D., University of Maryland.

Terrence P. Tougas, Assistant Professor, Chemistry; B.A., State University College of New York; M.S., Ph.D., University of Massachusetts.

Jerry Waldman, Associate Professor, Physics; B.A., M.A., Columbia University, Ph.D., Massachusetts Institute of Technology.

Arthur C. Watterson, Jr., Professor, Chemistry; B.S., Geneva College (Switzerland); Ph.D., Brown University.

I. Jacob Weinberg, Professor, Mathematics; B.S., Yeshiva University; S.M., Ph.D., Massachusetts Institute of Technology.

Joyce W. Williams, Assistant Professor, Mathematics; B.A., University of Minnesota; M.S., Ph.D., University of Illinois.

Martin Wilner, Professor, Physics; B.S., Rensselaer Polytechnic Institute; M.S., Yale University; Ph.D., Massachusetts Institute of Technology.

Richard E. Winslow, Assistant Professor, Mathematics; B.A., Columbia University, M.A., Ph.D., Brandeis University.

Chuen Wong, Assistant Professor, Physics; Dip. Sci. Chung Chi College (Hong Kong) Ph.D., Case Institute of Technology.

Lee-Jun Wong, Assistant Professor, Biological Sciences; B.S., National Taiwan University; Ph.D., Ohio University.

Shan S. Wong, Associate Professor, Chemistry; B.S., Oregon State University; Ph.D., Ohio State University.

COLLEGE OF EDUCATION

M. Virginia Biggy, Dean

Professors; M. Virginia Biggy, Thomas G. Devine, Richard M. Lyons, Mary E. McGauvran, Margaret R. Shannon, Emerita.

Associate Professors: Norman F. Benson, John J. Catallozzi, Penelope Z. Demogenes, Alice G. Kiernan, Anne M. McParland, Dorothy V. Meyer, William T. Phelan, Robert B. Wagner.

Assistant Professors: Douglas H. Adamson.

Adjunct Faculty: Ado Commito

The preparation of graduates for professional careers in education has been a responsibility of the University of Lowell and its predecessor institution, Lowell State College, since 1894. Graduates of degree programs in education have rendered service as teachers, specialists, and administrators in the schools, colleges and universities, and public and private enterprises of the Commonwealth and the nation. The College of Education continues an historic commitment to education through its undergraduate and graduate degree programs and is committed to maintaining and continuously improving quality programs in education which will produce the high calibre personnel which the schools of the future will require. For information concerning graduate degree programs in education, see the *Graduate School Catalogue*.

OBJECTIVE OF THE COLLEGE OF EDUCATION

Through degree programs which prepare intellectually able, liberally educated, and professionally competent teachers and other educational and administrative personnel for leadership roles in school and non-school settings, the faculty of the College of Education seek to improve instruction for students in the public and independent schools in the Commonwealth and the nation.

COLLEGE ORGANIZATION AND GOVERNANCE

The College of Education is organized into three centers and is administered by a dean who is assisted by an advisory council. The three centers are responsible for developing course offerings and programs of studies. Although the faculty of the College has overall responsibility for all academic policies of the College, the Academic Standards and Admissions Committee is responsible for developing and enforcing decisions on all candidates applying for admission to the College of Education, and for reviewing the appeals of students who fail to meet the requirements for admission to or retention in degree programs.

Dean's Advisory Council

Dr. Norman F. Benson, Chairman of the Faculty

Dr. John J. Catallozzi, Coordinator, Center for the Study of Curriculum and Instruction.

Mrs. Penelope Z. Demogenes, Coordinator, Office of Field Services

Dr. Anne M. McParland, Coordinator, Center for Reading and Language.

Dr. Dorothy V. Meyer, Coordinator, Center for Administration, Planning, and Policy.

Student to be elected.

BACCALAUREATE DEGREE PROGRAMS

The College of Education offers an undergraduate program in elementary education leading to the degree of Bachelor of Arts. Course requirements for the Bachelor of Arts degree in elementary education have been determined by specific professional objectives and are subject to the recommendations of the National Council for the Accreditation of Teacher Education, and the Massachusetts Regulations for the Certification of Educational Personnel. Course requirements are specified in terms of the total curriculum.

The degree programs in elementary education are designed to prepare students for professional certification as teachers of grades one through six in the elementary schools. These degree programs are unique, and unlike most programs in elementary education, in that they require students to complete not only a professional major in elementary education but also a liberal arts major in one of the following areas: American studies, art, English, French, history, psychology, sociology, or Spanish. The requirements for each of the academic majors are set by the concerned academic department of the College of Liberal Arts in collaboration with the

College of Education. The professional major in elementary education requires content for the teaching specialty, humanistic and behavioral science foundations of educational practice, teaching and learning history, and practicum in teaching.

By vote of the Trustees of the University, this program will be suspended with the class of 1985. After that date, all teacher preparation will be at the graduate level.

All degree programs have the following requirements:

University Core Requirements	34 credits
Allied Course Requirements	8
Professional Major: Elementary Education	
A. Cognate Course Requirements	14
B. Pre-Practicum Requirements	23
C. Practicum in Teaching	12
Academic Major	30-33
Electives	3-6
Minimum Requirements for the Degree	127

Students anticipating transfer to the College of Education should consult the Dean.

GENERAL COLLEGE REQUIREMENTS

Academic Requirements for the Degree

In order to qualify for the Bachelor of Arts offered by the College of Education, each student must comply with the University Core Requirements, must conform to the rules of the College of Education which govern degrees and major studies for such degrees, must complete all degree requirements with a cumulative average of not less than 2.50, and must achieve averages of 2.50 or better in each of his or her academic and professional majors.

Admission and Retention Policies

Admission to the College of Education is selective and differential admissions criteria above and beyond the minimum requirements will be applied when limited resources render it necessary to establish limitations upon enrollments.

To qualify for continued matriculation in the College of Education, students must meet the following requirements at the end of the freshman year and *at the end of each semester thereafter*:

A cumulative grade-point average of 2.50 or better must be earned in all courses taken in the University.

A cumulative grade-point average of 2.50 or better must be earned in all required and elective courses which are taken in the University and which are credited to the student's academic major.

A cumulative grade-point average of 2.50 or better must be earned in all courses in education which are taken in the University, with a grade of "C" or better in each course.

Satisfactory evidence of effective communication skills in English, and a grade "C" or better in 42-101-College Writing I and in 42-102-College Writing II, respectively.

Professional courses in educational foundations, curriculum and instruction, and the practicum in teaching in which grades of "CD", "D", "F", or "U" have been earned may not be deleted from the student's cumulative average and may not be repeated for credit.

Students who do not satisfy these retention requirements may not continue as degree candidates in the College of Education and their enrollment in the College accordingly is terminated.

Students whose enrollment as a degree candidate in the College of Education has been terminated may not enroll for credit or for audit in any course in curriculum and instruction. All such courses carry an "02" prefix.

Application for Admission to Professional Education

Students enrolled as a degree candidate in the College of Education must file an application for admission to professional education at the end of their sophomore year. The procedures and requirements are:

The deadline for filing an application for admission to professional education is April 1 of the student's sophomore year. Application forms are available in the Education Office in Dugan Hall.

Completion of no less than 66 semester credits of required course work (exclusive of Physical Activities courses) by the end of the sophomore year with a cumulative grade-point average of 2.50 or better for all course work transferred and also a cumulative grade-point average of 2.50 or better for all course work taken in the University.

Completion of no less than 24 semester credits of required course work in the student's academic major with a cumulative grade-point average of 2.50 or better for courses transferred and a grade-point average of 2.50 or better for courses taken in the University.

Satisfactory evidence of effective communication skills in English, and a grade of "C" or better in 42-101-College Writing I and in 42-102-College Writing II, respectively.

Completion of the required course in child psychology with a grade of "C" or better.

Completion of the following courses in education: 01-350-Field Experiences; 01-351-The Public Schools; and 01-384-Education and Cultural Diversity; with a cumulative grade-point average of 2.50 or better, and with a grade of "C" or better earned in each course.

Application for and Requirements for the Practicum in Teaching

All students enrolled in a degree program in the College of Education must file an application for admission to the Practicum in Teaching. The application forms can be obtained in the Education Office in Dugan Hall. Completed applications must be filed by May 1 of the student's junior year.

Decisions on the placement of students in the public schools for the Practicum in Teaching, and the professional contacts and arrangements pertaining thereto, are made by the Coordinator of Field Services only.

The requirements for admission to and enrollment in the Practicum in Teaching include the following:

Completion of no less than 101 semester credits of the degree program by the end of the junior year with a grade-point average of 2.50 or better and with no record of incompleting courses.

Completion of all required and elective courses in the student's academic major by the end of the junior year with a grade-point average of 2.50 or better and with no record of incompleting courses.

Completion of all courses in education required by the end of the junior year with a grade-point average of 2.50 or better, with no record of incompleting courses, and with no grade less than "C"

Completion of all courses in the University Core Requirements and allied course requirements as specified by the College of Education.

Filing with the application for admission to the Practicum in Teaching up-to-date medical evidence of freedom from tuberculosis by means of clinical testing or chest x-ray. The filing of this medical statement is a legal requirement of the Commonwealth of Massachusetts for teaching in the public schools. Students who fail to file this evidence with their applications will not be considered for admission to the Practicum in Teaching.

Evidence of sound emotional and physical health which will enable the student to provide safe, competent practice in teaching. In special cases, the Academic Standards and Admissions Committee may require the student to submit statements of physical and/or mental health from physicians or psychiatrists licensed by the Commonwealth of Massachusetts. Following a review of such evidence, the Committee may recommend that the student be denied admission to the Practicum in Teaching and/or that his or her enrollment as a degree candidate in the College of Education be terminated.

Intercollegiate Transfer and Admission to the College of Education

Students who wish to transfer from the College of Liberal Arts must file an application for admission, together with the transcript of their permanent record cards, with the Dean of the College of Education by November 1 for spring semester transfer and by April 1 for fall semester transfer. In order to complete degree requirements within the normal four-year schedule, students are advised to file an application in the spring semester of their freshman year. In no case may an application be filed later than April 1 of the student's sophomore year.

The requirements which students must meet in order to qualify for admission are:

Completion of no less than 30 semester credits of course work by the end of the freshman year of 60 semester credits by the end of the sophomore year with a cumulative grade-point average of 2.50 or better for all course work taken in the University. Students who previously transferred to a college in the University. Students who previously transferred to a college in the University from another institution must also have a cumulative grade-point average of 2.50 or better for all course work transferred.

Completion of three or more courses which have been elected from the required course listing for the student's academic major with a cumulative grade-point average of 2.50 or better. The student must be enrolled in one of the following academic majors: American studies, art, English, French, history, psychology, sociology, or Spanish.

Satisfactory evidence of effective communication skills in English, together with a grade of "C" or better in 42-101-College Writing I and 42-102-College Writing II, respectively.

Students who are accepted for transfer and admission to the College may expect recognition of previously completed courses if these are equivalent to those which are required by the degree programs of the College of Education. Courses which are not relevant may not be credited to degree requirements or to the minimum degree requirement of 127 credits.

An applicant for admission who was previously admitted to the University as a transfer student from an institution in which he or she was enrolled in an education program must comply with the requirements for admission to the College of Education. *Credit for practicum courses in teaching (student-teaching) and courses in curriculum and instruction (methods courses) may not be transferred to the College of Education, irrespective of any previous recognition by the Office of Admissions or by other colleges of the University. Credit for cognate courses in educational foundations, if equivalent to those required in degree programs of the College of Education, may be transferred from a baccalaureate degree-granting institution.*

Transfer and Admission from Other Institutions

All prospective transfer students *must* meet with the Dean of the College before acceptance. Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University requirements when a student is admitted to the University, and are also evaluated by the College of Education in terms of its college and program requirements at the time a student is accepted for matriculation as a degree candidate in the College. Courses which are transferred to the University under the provisions of the Massachusetts Transfer Compact and which are not creditable to requirements of the College of Education or as unrestricted elective courses will be listed on the student's permanent record card but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University under Massachusetts Transfer Compact subsequently makes an intercollegiate transfer to the College of Education, all previously completed courses, including transferred courses from other institutions, will be reevaluated in terms of their applicability to degree requirements of the College of Education.

An individual who is admitted to the University as a transfer student from an institution in which he or she was enrolled in an education program must comply with the requirements for admission to the College of Education as a matriculating student. *Credit for practicum courses in teaching (student teaching) and courses in curriculum and instruction (methods courses) may not be transferred to the College of Education irrespective of any previous recognition by the Office of Admissions. Credit for cognate courses in educational foundations, if equivalent to those required in degree programs of the College of Education, may be transferred from a baccalaureate degree-granting institution.*

The requirements which students must meet in order to qualify for admission to the College of Education are:

Completion of no less than 30 semester credits of course work by the end of the freshman year, or 60 semester credits by the end of the sophomore year with a cumulative grade-point average of 2.50 or better for all course work transferred.

Completion of two or more courses which are equivalent to courses required in the student's academic major and in which a cumulative grade-point average of 2.50 or better has been earned. The student must be enrolled in one of the following academic majors: American studies, art, English, French, history, psychology, sociology, or Spanish.

Satisfactory evidence of effective communication skills in English, together with a grade of "C" or better in College Writing I and College Writing II, respectively.

Elective Courses in Education

Professional courses in curriculum and instruction and in the practicum in teaching are available *only to students who have been admitted to a degree program in the College of Education.*

Undergraduate course offerings in the humanistic and behavioral science foundations of education are open on a space available basis to students who are matriculating for degrees in other colleges of the University. Admission to these courses requires the approval of the Dean of the College of Education.

Appeals Procedures

Applicants who do not qualify for intercollegiate transfer and admission to the College of Education, and students who have been notified in writing that their enrollments as degree candidates in the College of Education have been terminated may submit written petitions to the Academic Standards and Admissions Committee for a review of their records and for permission to reapply on the appropriate filing date in the semester which immediately follows the semester in which they have applied for intercollegiate transfer and admission, or in which their enrollments were terminated. Students may not petition the Committee more than once for permission to reapply. All decisions of the Committee in evaluating such petitions are final.

Grading Policies

With the exception of the Practicum in Teaching courses, all courses offered by the College of Education are graded in accordance with the qualitative letter grades employed by the University to characterize the quality of a student's performance in a course.

Courses offered by the College in which grades of "CD", "D", "F", or "U" have been earned may not be deleted from the student's cumulative average during his or her enrollment in the College of Education and may not be repeated for credit.

The Practicum in Teaching courses are graded on the "S" or "U" basis. A grade of "S" (satisfactory) indicates that a student's performance in teaching merits an evaluation of "C" or better. Supportive evidence of each student's performance in teaching is provided in his or her placement file and is made available to prospective employers. Course credit granted to students for courses in which a grade of "S" has been assigned are not computed in cumulative averages.

Students who earn a grade of "U" (unsatisfactory) in a Practicum in Teaching course are automatically terminated as a degree candidate in the College of Education. A grade of "U" entered on the student's permanent record card indicates that attempted course credits have not been granted. This grade does not prejudice the student's academic standing in the University since such credits are not counted toward the grade-point average.

Semester Course Load

Students enrolled in degree programs of the College of Education are required to register as full-time students each semester and to carry a typical course load of 15-18 credits. The College does not permit students to register

for less than full-time study, and all students are required, therefore, to register for and to complete a minimum of 12 credits each semester.

Course Withdrawal

All courses offered by the College of Education which operate on the semester basis are subject to the withdrawal policies of the University as stated elsewhere in this publication under the heading "Academic Policies." Students may withdraw with notations of "W" from curriculum and instruction courses which operate on an 8 week basis. Procedures for withdrawal from such courses are the same as those for regular courses except that the official "course drop cards" must be filed with the Office of the Registrar no later than the 14th class day of the course.

A student who is enrolled in a Practicum in Teaching course is permitted to withdraw only for documented medical or personal emergency reasons, or for personal unsuitability for teaching. A student whose performance in teaching has been satisfactory prior to withdrawing for medical or personal emergency reasons is permitted to withdraw with the notation of "W". *All other withdrawals from the Practicum in Teaching course are recorded on the student's permanent record card with a grade of "U".*

A student may be withdrawn from the Practicum in Teaching at any time with a grade of "U" when his/her performance in teaching is unsatisfactory; when he/she has shown a record of irresponsibility in carrying out his/her teaching commitments; when he/she has been absent from teaching for more than two days without a satisfactory documented reason; or when he/she engages in activities, including employment, which interfere with the performance of assigned responsibilities and which violate the terms of his/her teaching contract.

A student who withdraws or is withdrawn from a practicum in Teaching course with a grade of "U" is automatically terminated as a degree candidate in the College of Education and is not permitted to file an appeal.

Withdrawal from the College of Education

Students who wish to withdraw from a degree program in the College of Education are required to notify in writing the Dean of the College of Education prior to initiating procedures for making an intercollegiate transfer within the University.

Application for Professional Certification

Upon completion of a baccalaureate degree program in the College of Education, senior students may file an application for professional certification in Massachusetts. When the application materials are complete, the College will recommend the student for a teaching certificate and the appropriate endorsement will be entered on his or her permanent record card. The Massachusetts Department of Teacher Certification has the sole legal responsibility for granting certification.

ELEMENTARY EDUCATION DEGREE PROGRAMS

The degree programs in elementary education include the following components: University Core Requirements; a professional major in elementary education; an academic major in one of the following liberal arts disciplines: American studies, art, English, French, history, psychology, sociology, or Spanish; a certification minor in communications, social studies, or mathematics and science; and allied course requirements.

The professional major in elementary education includes course offerings in the humanistic and behavioral foundations which provide students with sets of contexts in which educational problems can be understood and interpreted; course work and field experiences in curriculum and instruction; and a practicum in teaching. The requirements specified by the Commonwealth of Massachusetts regulations for certification as a teacher in the elementary schools are also incorporated. They include: 1. knowledge of and completion of no less than 36 semester hours of course work in the subject matter of elementary education: reading, communication, mathematics, science, social studies, the arts, health and physical education; 2. knowledge of one or more of the above fields at a level that approximates a college minor; 3. knowledge of the relationships among these fields; 4.

completion of a pre-practicum consisting of no less than 21 semester hours of course work and other experiences as defined in certification Standards II-V; and 5. completion of a practicum in teaching judged successful on the basis of certification Standards I-V.

Elementary Education and American Studies

	sem. hrs.
I. University Core Requirements	
42-101 College Writing I	3
42-102 College Writing II	3
Area I (Behavioral and Social Sciences)	
46-101 Introduction to American Politics	3
47-261 Child Psychology	3
Area I elective	3
Area II (Humanities)	
42- American literature "263 + "	3
57-287 Art and the Child <i>OR</i>	3
58-101 Appreciation of the Visual Arts	3
74-162 American Music <i>OR</i>	3
74-161 Music of Western Civilization	
Area III (Mathematics and Science)	
92-121 Pre-Calculus Math	3
92-209 Intro. to Basic	3
83-102 Life Science II <i>AND</i>	3
83-104 Life Science II Laboratory	1
II. Allied Course Requirements	3
30-103 Life and Health	3
39- Physical Activities	2
42-308 Analysis of Modern English	3
III. Academic Major: American Studies	
43-305 American Intellectual History I <i>AND</i>	3
43-306 American Intellectual History II <i>OR</i>	3
43-313 American Social History I <i>AND</i>	
43-314 American Social History II	
Elective	3
Elective	3
Discipline #1 elective "200 + "	3
Discipline #1 elective "200 + "	3
Discipline #2 elective "200 + "	3
Discipline #2 elective "300 + "	3
40 Interdisciplinary elective "300 + "	3
40-401 American Studies Seminar	3
IV. Professional Major: Elementary Education	
A. Cognate Course Requirements:	
01-350 Field Experiences I	1
01-350 Field Experiences II	1
01-351 The Public Schools	3
01-361 Measurement and Evaluation	3
01-384 Education and Cultural Diversity	3
01-391 Philosophy of Education <i>OR</i>	3
01-392 Philosophy and Moral Issues in Education	
B. Pre-Practicum Requirements:	
02-361 Reading	3
02-362 Language	3
02-363 Mathematics	3
02-364 Analysis of Teaching	3
02-367 Field-based Pre-Practicum	0
02-368 Social Studies and Science	3
02-460 Seminar I	1
02-461 Seminar II	1
02-481 Reading Disabilities	3
02-483 Literature and Children	3
C. Practicum in Teaching:	
02-462 Teaching: Elementary Education I	6
02-463 Teaching: Elementary Education II	6
V. Electives: Non-Major	
Elective	3
Elective	3
VI. Minimum Credits for the Degree	

Elementary Education and Art

	sem.	hrs.
I. University Core Requirements		
42-101 College Writing I		3
42-102 College Writing II		3
Area I (Behavioral and Social Sciences)		
43- American History elective		3
46-101 Introduction to American Politics		3
47-261 Child Psychology		3
Area II (Humanities)		
42- American literature "263 + "		3
42-308 Analysis of Modern English		3
74-162 American Music <i>OR</i>		3
74-161 Music of Western Civilization		
Area III (Mathematics and Science)		
92-121 Pre-Calculus Math		3
92-209 Intro. to Basic		3
83-102 Life Science II <i>AND</i>		3
83-104 Life Science II Laboratory		1
II. Allied Course Requirements		
30-103 Life and Health		3
39- Physical Activities		2
III. Academic Major: Art		
58-203 Survey of Art I **		3
58-204 Survey of Art II **		3
58-3 Art History elective "300"		3
58-3 Art History elective "300"		3
57-251 Visual Design I **		3
57-255 Drawing I **		3
57-261 Photography I		3
57-267 Printmaking		3
57-271 Painting I Studio		3
57-3 Studio Art elective "300"		3
57-3 Studio Art elective "300"		3
57-3 Studio Art elective "300"		3
**Must be taken prior to enrollment in other art courses.		
IV. Professional Major: Elementary Education		
A. Cognate Course Requirements:		
01-350 Field Experiences I		1
01-350 Field Experiences II		1
01-351 The Public Schools		3
01-361 Measurement and Evaluation		3
01-384 Education and Cultural Diversity		3
01-391 Philosophy of Education <i>OR</i>		3
01-392 Philosophy and Moral Issues in Education		
B. Pre-Practicum Requirements:		
02-361 Reading		3
02-362 Language		3
02-363 Mathematics		3
02-364 Analysis of Teaching		3
02-367 Field-based Pre-Practicum		0
02-368 Social Studies and Science		3
02-460 Seminar I		1
02-461 Seminar II		1
02-481 Reading Disabilities		3
02-483 Literature and Children		3
C. Practicum in Teaching:		
02-462 Teaching: Elementary Education I		6
02-463 Teaching: Elementary Education II		6
V. Electives: Non-Major		
Elective		3
VI. Minimum Credits for the Degree		127

Elementary Education and English

	sem.	hrs.
I. University Core Requirements		
42-101 College Writing I		3
42-102 College Writing II		3
Area I (Behavioral and Social Sciences)		
43- American History elective		3
46-101 Introduction to American Politics		3
47-261 Child Psychology		3
Area II (Humanities)		
Foreign Language, Intermediate		3
Foreign Language, Intermediate		3
57-287 Art and the Child <i>OR</i>		3
58-101 Appreciation of the Visual Arts		
Area III (Mathematics and Science)		
92-121 Pre-Calculus Math		3
92-209 Intro. to Basic		3
83-102 Life Science II <i>AND</i>		3
83-104 Life Science II Laboratory		1
II. Allied Course Requirements		
30-103 Life and Health		3
39- Physical Activities		2
74-162 American Music <i>OR</i>		3
74-161 Music of Western Civilization		
III. Academic Major: English		
42-201 Great Books of Antiquity		3
42-291 History of English Literature I		3
42-292 History of English Literature II		3
42-293 History of American Literature I		3
42-294 History of American Literature II		3
42- Elective "200+"		3
42-308 Analysis of Modern English		3
42-3 Elective "300+" Category I, II, or III**		3
42-3 Elective "300+" Category I, II, or III**		3
42-3 American Lit. (post 1820) elective "300+"		3
42-423/424 Shakespeare I or II		3
**Category I-Medieval and Renaissance		
Category II-Restoration and Neoclassical		
Category III-Romantic and Victorian		
IV. Professional Major: Elementary Education		
A. Cognate Course Requirements:		
01-350 Field Experiences I		1
01-350 Field Experiences II		1
01-351 The Public Schools		3
01-361 Measurement and Evaluation		3
01-384 Education and Cultural Diversity		3
01-391 Philosophy of Education <i>OR</i>		3
01-392 Philosophical and Moral Issues in Education		
B. Pre-Practicum Requirements:		
02-361 Reading		3
02-362 Language		3
02-363 Mathematics		3
02-364 Analysis of Teaching		3
02-367 Field-based Pre-Practicum		0
02-368 Social Studies and Science		3
02-460 Seminar I		1
02-461 Seminar II		1
02-481 Reading Disabilities		3
02-483 Literature and Children		3
C. Practicum in Teaching:		
02-462 Teaching: Elementary Education I		6
02-463 Teaching: Elementary Education II		6
V. Electives: Non-Major		
Elective		3
VI. Minimum Credits for the Degree		127

Elementary Education and History

I. University Core Requirements	sem. hrs.
42-101 College Writing I	3
42-102 College Writing II	3
Area I (Behavioral and Social Sciences)	
46-101 Introduction to American Politics	3
47-261 Child Psychology	3
Area I elective	3
Area II (Humanities)	
42- American literature "263 +"	3
57-287 Art and the Child <i>OR</i>	3
58-101 Appreciation of the Visual Arts	
74-162 American Music <i>OR</i>	3
74-161 Music of Western Civilization	
Area III (Mathematics and Science)	
92-121 Pre-Calculus Math	3
92-209 Intro. to Basic	3
83-102 Life Science II <i>AND</i>	3
83-104 Life Science II Laboratory	1
II. Allied Course Requirements	
30-103 Life and Health	3
39- Physical Activities	2
42-308 Analysis of Modern English	3
III. Academic Major: History	
43-105 Western Civilization to 1715	3
43-106 Western Civilization since 1715	3
43-European History elective "200 +"	3
43-European History elective "200 +"	3
43-American History elective "200 +"	3
43-Third World History elective "200 or 300" **	3
43-370 Introduction to Historical Method	3
43-3 American History elective "300"	3
43-3 American History elective "300"	3
43-3 American History elective "300"	3
43-432 Research Seminar in History	3
**43-228, 43-367, 43-206, 43-280, 43-312, 43-210, 43-246, 43-248, 43-286, or 43-366.	
IV. Professional Major: Elementary Education	
A. Cognate Course Requirements:	
01-350 Field Experiences I	1
01-350 Field Experiences II	1
01-351 The Public Schools	3
01-361 Measurement and Evaluation	3
01-384 Education and Cultural Diversity	3
01-391 Philosophy of Education <i>OR</i>	3
01-392 Philosophy and Moral Issues in Education	
B. Pre-Practicum Requirements:	
02-361 Reading	3
02-362 Language	3
02-363 Mathematics	3
02-364 Analysis of Teaching	3
02-367 Field-based Pre-Practicum	0
02-368 Social Studies and Science	3
02-460 Seminar I	1
02-461 Seminar II	1
02-481 Reading Disabilities	3
02-483 Literature and Children	3
C. Practicum in Teaching:	
02-462 Teaching: Elementary Education I	6
02-463 Teaching: Elementary Education II	6
V. Electives: Non-Major	
Elective	3
VI. Minimum Credits for the Degree	
	127

Elementary Education and Psychology

	sem. hrs.
I. University Core Requirements	
42-101 College Writing I	3
42-102 College Writing II	3
Area I (Behavioral and Social Sciences)	
43 American History elective	3
46-101 Introduction to American Politics	3
Area I elective (Non-Psychology)	3
Area II (Humanities)	
42- American literature "263 + "	3
57-287 Art and the Child <i>OR</i>	3
58-101 Appreciation of the Visual Arts	
74-162 American Music <i>OR</i>	3
74-161 Music of Western Civilization	
Area III (Mathematics and Science)	
92-121 Pre-Calculus Math	3
92-209 Intro. to Basic	3
83-102 Life Science II <i>AND</i>	3
83-104 Life Science II Laboratory	1
II. Allied Course Requirements	
30-103 Life and Health	3
39- Physical Activities	2
42-308 Analysis of Modern English	3
III. Academic Major: Psychology	
47-101 General Psychology	3
47-209 Social Psychology <i>OR</i>	3
47-255 Community Psychology	
47-232 Psychology of Personality <i>OR</i>	3
47-272 Abnormal Psychology	
47-261 Child Psychology	3
47-269 Research Methods	3
47-277 Sensation and Perception	3
47-3 Research Laboratory course. Select from	3
47-375, 47-376, 47-377, 47-378, 47-379, or 47-380	
47-3 Elective "300 + "	3
47-3 Elective "300 + "	3
47-4 Elective "400"***	3
47-4 Elective "400"***	3
**Not more than one course may be selected from 47-491 or 47-496.	
IV. Professional Major: Elementary Education	
A. Cognate Course Requirements:	
01-350 Field Experiences I	1
01-350 Field Experiences II	1
01-351 The Public Schools	3
01-361 Measurement and Evaluation	3
01-384 Education and Cultural Diversity	3
01-391 Philosophy of Education <i>OR</i>	3
01-392 Philosophy and Moral Issues in Education	
B. Pre-Practicum Requirements:	
02-361 Reading	3
02-362 Language	3
02-363 Mathematics	3
02-364 Analysis of Teaching	3
02-367 Field-based Pre-Practicum	0
02-368 Social Studies and Science	3
02-460 Seminar I	1
02-461 Seminar II	1
02-481 Reading Disabilities	3
02-483 Literature and Children	3
C. Practicum in Teaching:	
02-462 Teaching: Elementary Education I	6
02-463 Teaching: Elementary Education II	6
V. Electives: Non-Major	
Elective	3
VI. Minimum Credits for the Degree	127

Elementary Education and Sociology

	sem. hrs.
I. University Core Requirements	
42-101 College Writing I	3
42-102 College Writing II	3
Area I (Behavioral and Social Sciences)	
43- American History elective	3
46-101 Introduction to American Politics	3
47-261 Child Psychology	3
Area II (Humanities)	
42- American literature "263 + "	3
57-287 Art and the Child <i>OR</i>	3
58-101 Appreciation of the Visual Arts	
74-162 American Music <i>OR</i>	3
74-161 Music of Western Civilization	
Area III (Mathematics and Science)	
92-121 Pre-Calculus Math	3
92-209 Intro. to Basic	3
83-102 Life Science II <i>AND</i>	3
83-104 Life Science II Laboratory	1
II. Allied Course Requirements	
30-103 Life and Health	3
39- Physical Activities	2
42-308 Analysis of Modern English	3
III. Academic Major: Sociology	
48-101 Introduction to Sociology	3
48 Elective	3
48 Elective	3
48 Elective	3
48 Elective	3
48-321 Social Theory	3
48-3 Elective "300"	3
48-2 Elective "300"	3
48-402 Sociological Research	3
48-4 Elective "400"	3
IV. Professional Major: Elementary Education	
A. Cognate Course Requirements:	
01-350 Field Experiences I	1
01-350 Field Experiences II	1
01-351 The Public Schools	3
01-361 Measurement and Evaluation	3
01-384 Education and Cultural Diversity	3
01-391 Philosophy of Education <i>OR</i>	3
01-392 Philosophy and Moral Issues in Education	
B. Pre-Practicum Requirements:	
02-361 Reading	3
02-362 Language	3
02-363 Mathematics	3
02-364 Analysis of Teaching	3
02-367 Field-based Pre-Practicum	0
02-368 Social Studies and Science	3
02-460 Seminar I	1
02-461 Seminar II	1
02-481 Reading Disabilities	3
02-483 Literature and Children	3
C. Practicum in Teaching:	
02-462 Teaching: Elementary Education I	6
02-463 Teaching: Elementary Education II	6
V. Electives: Non-Major	
Elective	3
Elective	3
VI. Minimum Credits for the Degree	127

Elementary Education and Spanish

I. University Core Requirements	sem. hrs.
42-101 College Writing I	3
42-102 College Writing II	3
Area I (Behavioral and Social Sciences)	
43- American History elective	3
46-101 Introduction to American Politics	3
47-261 Child Psychology	3
Area II (Humanities)	
42- American literature "263 + "	3
57-287 Art and the Child <i>OR</i>	3
58-101 Appreciation of the Visual Arts	
74-162 American Music <i>OR</i>	3
74-161 Music of Western Civilization	
Area III (Mathematics and Science)	
92-121 Pre-Calculus Math	3
92-209 Intro. to Basic	3
83-102 Life Science I <i>AND</i>	3
83-104 Life Science II Laboratory	1
II. Allied Course Requirements	
30-103 Life and Health	3
39- Physical Activities	2
42-308 Analysis of Modern English	3
III. Academic Major: Spanish	
54-231 Spanish Oral Expression I	3
54-232 Spanish Oral Expression II	3
54-243 Advanced Spanish Grammar	3
54-245 Advanced Spanish Conversation	3
54-347 Advanced Spanish Composition	3
54 Spanish language elective**	3
54 Spanish literature elective "300 or 400" ***	3
54Spanish literature elective "300 or 400" ***	3
54Spanish literature elective "300 or 400" ***	3
54Spanish literature elective "300 or 400" ***	3
54Spanish literature elective "300 or 400" ***	3
**Select from 54-249, 54-313, or 54-372.	
***Course must be conducted in Spanish.	
IV. Professional Major: Elementary Education	
A. Cognate Course Requirements:	
01-350 Field Experiences I	1
01-350 Field Experiences II	1
01-351 The Public Schools	3
01-361 Measurement and Evaluation	3
01-384 Education and Cultural Diversity	3
01-391 Philosophy of Education <i>OR</i>	3
01-392 Philosophy and Moral Issues in Education	
B. Pre-Practicum Requirements:	
02-361 Reading	3
02-362 Language	3
02-363 Mathematics	3
02-364 Analysis of Teaching	3
02-367 Field-based Pre-Practicum	0
02-368 Social Studies and Science	3
02-460 Seminar I	1
02-461 Seminar II	1
02-481 Reading Disabilities	3
02-483 Literature and Children	3
C. Practicum in Teaching:	
02-462 Teaching: Elementary Education I	6
02-463 Teaching: Elementary Education II	6
V. Electives: Non-Major	
Elective	3
VI. Minimum Credits for the Degree	127

Elementary Education and French

	sem. hrs.
I. University Core Requirements	
42-101 College Writing I	3
42-102 College Writing II	3
Area I (Behavioral and Social Sciences)	
43- American History elective	3
46-101 Introduction to American Politics	3
47-261 Child Psychology	3
Area II (Humanities)	
42- American literature "263 + "	3
57-287 Art and the Child <i>OR</i>	3
58-101 Appreciation of the Visual Arts	
74-162 American Music <i>OR</i>	3
74-161 Music of Western Civilization	
Area III (Mathematics and Science)	
92-121 Pre-Calculus Math	3
92-209 Intro. to Basic	3
83-102 Life Science II <i>AND</i>	3
83-104 Life Science II Laboratory	1
II. Allied Course Requirements	
30-103 Life and Health	3
39- Physical Activities	2
42-308 Analysis of Modern English	3
III. Academic Major: French	
50-231 Reading and Conversing in French I	3
50-232 Reading and Conversing in French II	3
50-244 Advanced French Grammar	3
50-246 Advanced French Conversation	3
50-348 Advanced French Composition	3
50-372 Applied Linguistics	3
50 French literature elective "300 or 400" ***	3
50French literature elective "300 or 400" ***	3
50French literature elective "300 or 400" ***	3
50French literature elective "300 or 400" ***	3
**Course must be conducted in French.	
IV. Professional Major: Elementary Education	
A. Cognate Course Requirements:	
01-350 Field Experiences I	1
01-350 Field Experiences II	1
01-351 The Public Schools	3
01-361 Measurement and Evaluation	3
01-384 Education and Cultural Diversity	3
01-391 Philosophy of Education <i>OR</i>	3
01-392 Philosophy and Moral Issues in Education	
B. Pre-Practicum Requirements:	
02-361 Reading	3
02-362 Language	3
02-363 Mathematics	3
02-364 Analysis of Teaching	3
02-367 Field-based Pre-Practicum	0
02-368 Social Studies and Science	3
02-460 Seminar I	1
02-461 Seminar II	1
02-481 Reading Disabilities	3
02-483 Literature and Children	3
C. Practicum in Teaching:	
02-462 Teaching: Elementary Education I	6
02-463 Teaching: Elementary Education II	6
V. Electives: Non-Major	
Elective	3
Elective	3
VI. Minimum Credits for the Degree	127

GRADUATE PROGRAM IN ELEMENTARY EDUCATION

The College of Education offers a graduate program in elementary education which leads to the degree of Master of Education (Ed.M.). This degree program is designed to prepare students for professional certification as teachers of grades one through six in the elementary schools.

The requirements of admission to this full-time graduate degree program include the following:

An earned Bachelor of Arts degree with an academic major in American studies, art, English, French, history, psychology, sociology, or Spanish.

Satisfactory completion of the following undergraduate courses in the Elementary Education Fields of Knowledge and in the Communications Minor required for certification:

- American literature (3 s.h.)
- Analysis of Modern English (3 s.h.)
- American history (3 s.h.)
- Introduction to American Politics (3 s.h.)
- Child Psychology (3 s.h.)
- Art and the Child *OR* Appreciation of the Visual Arts (3 s.h.)
- American Music *OR* Music of Western Civilization (3 s.h.)
- Pre-Calculus Mathematics (3 s.h.)
- Introduction to Theory of Computer Programming (3 s.h.)
- Life Science II (3 s.h.) *AND* Life Science II Laboratory (1 s.h.)
- Life and Health (3 s.h.)
- Physical Activities (2 s.h.)

The above courses may be taken as part of the undergraduate University Core Requirements, academic major, or unrestricted electives.

Other requirements for admission to the graduate degree program in elementary education include the four-year cumulative grade-point average, evidence of effective communication skills in English, cumulative grade-point average in the academic major, and performance on the Graduate Record Examination. Detailed information on these requirements may be obtained from the College of Education.

GRADUATE PROGRAM IN SECONDARY EDUCATION

This degree program in teacher education is designed for those who plan to teach in the secondary school and to achieve teacher certification in Secondary Education:

The degree requirements include the following:

I. Completion of these graduate courses at the University of Lowell:	sem. hrs.
01-601 Developmental Psychology	3
01-602 Measurement and Evaluation	3
01-614 History of American Education	3
04-645 Curriculum Development: Secondary School	3
04-6 Curriculum & Teaching: in the special academic field	3
06-605 Reading Education: Secondary	3
04-606 Seminar in Secondary Education	3
05-662 Equal Educational Opportunity	3
04-639 Teaching (Academic Field): Secondary	12
	Total = 36
	sem. hrs.
II. Completion of the Secondary Education Field of Knowledge Certification requirement pertinent to the Academic Field. These requirements (36 hours) are prerequisites and must have been completed satisfactorily as part of the baccalaureate degree.	
Students should get the necessary information from the College of Education.	

Foundations of Education (Course Prefix: 01)

01-301 EXISTENTIAL PSYCHOLOGY AND EDUCATION (3,0)3
An analysis of the works of various theorists such as Bettelheim, Frankl, May, and Sartre; a study of the application of their ideas to the development of curriculum and the practice of teaching in the public schools. Catallozzi.

- 01-302 SOCIAL PSYCHOLOGY AND EDUCATION** (3,0)3
A study of the major concepts presently used to explain, predict, and modify social interaction, motivation, attitudes, group behavior and leadership. The experiments conducted by Festinger, Rokeach, Milgram and Asch will be examined and utilized as a means of analyzing such classroom problems as poor behavior and attitudes, lack of motivation, and ineffective peer relationships. Catallozzi.
- 01-303 OPERANT CONDITIONING IN EDUCATION** (3,0)3
A study of learning and behavior based upon the theory of operant conditioning. The principles of positive and negative reinforcement, punishment, extinction, and schedules will be studied in detail and applied to learning and behavior problems which may be encountered in the classroom. Catallozzi.
- 01-312 INTRODUCTION TO CONTEMPORARY MORAL PROBLEMS** (3,0)3
An introduction to the major areas of ethical inquiry with an emphasis on moral obligation, character and duty, punishment, egoism, the good life. Historical and geographical differences in morality will be discussed, especially as they relate to contemporary problems concerning the relationships between people. Lyons.
- 01-321 HISTORY OF AMERICAN EDUCATION** (3,0)3
An analysis of the development of educational thought and practice in the United States within the context of American social, cultural, economic, and intellectual history. Catallozzi.
- 01-322 EDUCATION AND CONTEMPORARY SOCIETY** (3,0)3
Deals with social and cultural pressures on the educational system. Among the topics discussed are norms of authority, pupil decision-making, the influences of peer groups and education and contemporary life styles. Lyons.
- 01-323 MAN, MEDICINE AND MORALITY** (3,0)3
This course will emphasize those arguments which are used to justify moral decisions which confront medicine specifically and the public generally. The problems of drugs and personality alteration, artificial insemination, euthanasia, sterilization, truth and the patient, contraception, poverty and medical care, abortion, genetic engineering, and transplantation will be discussed as they relate to the problems of human values and moral obligation. Lyons.
- 01-331 SOCIAL ISSUES AND EDUCATION** (3,0)3
This course examines the role of education in dealing with contemporary social problems. Topics include education and social integration, alienation, occupational placement and the like. Phelan.
- 01-341 THE MEASUREMENT OF INTELLIGENCE** (3,0)3
This course traces the development of intelligence testing, considering topics such as the value of intelligence testing in terms of diagnosis, description, and predication, the heredity-environment controversy, and the correct use and interpretation of test results. Appropriate measurement and statistical background are provided where necessary. Catallozzi.
- 01-342 PSYCHOLOGICAL TESTING IN TODAY'S SOCIETY** (3,0)3
This course focuses on standardized cognitive and affective instruments currently in use, interpretation of test results, statistical concepts necessary for understanding how to analyze tests, and suggestions on how to write good tests. Catallozzi.
- 01-350 FIELD EXPERIENCES** I, II(3,0)3
This introductory course is designed to prepare for and provide students with beginning experiences in public school classrooms. Course methods will develop strategies for effective observation in elementary schools, basic skills for helping teachers and students, and discussion of field experiences.
- 01-351 THE PUBLIC SCHOOLS** (3,0)3
A course for the consumers - those who will be parents, taxpayers, school board or other public office holders. It will provide background on the responsibilities of school board members, the laws which have direct effect on schools, the organization of public schools, the curriculum and special services, fiscal concerns and the nationwide interest in assessment and accountability. Observation in elementary and secondary schools and at School Board and Finance Committee and meetings will be required.
- 01-361 MEASUREMENT AND EVALUATION** (3,0)3
This course introduces the prospective teacher to the principles and procedures of measurement and evaluation

that are essential to excellence in teaching. The main theme throughout is that evaluation is an integral part of instructional design and it involves: (1) the major categories of learning outcomes, (2) constructing teacher-made assessments relevant to the outcomes of learning, (3) using the assessments for feedback to improve tasks of learning and instruction. Material will be added on criterion-referenced assessment and defining and writing performance objectives for evaluation purposes. The Teacher will be able to select published tests with an understanding of the concepts of validity and reliability and, in addition, will be able to use standardized tests and interpret test scores. Practices or learning experiences will be presented to the student in areas requiring specific skills in measurement and evaluation. Commito.

01-371 EDUCATIONAL PSYCHOLOGY

II(3,0)3

Designed as an introduction to the study of human learning, this course covers such topics as efficiency in learning, testing, the psychology of teaching, and theories of human learning. Prerequisites: Limited to majors in Education or permission of the Dean. Catallozzi.

01-381 SOCIOLOGY OF EDUCATION

(3,0)3

The educational system is analyzed as an institution whose organizations and purposes reflect the socialization needs of the wider society. The school is studied as a social system and problems of authority, the role of the teacher, peer groups, aspirations and mobility of clientele are considered. Reciprocal relations of school and community are examined with reference to such factors as social class, family and occupational systems. Special emphasis is placed on the issue of equality of educational opportunity and on recent organizational changes which attempt to meet this goal. Opportunities for field work are included as an integral part of the course. Prerequisites: Limited to majors in Education or permission of the Dean. Phelan.

01-382 SOCIAL ORGANIZATION OF SCHOOLS AND SCHOOL SYSTEMS

(3,0)3

Problems of authority, coordination, and innovation in schools are examined from the perspective of different social factors in a school system. The role demands and expectations of teachers, pupils, principals, superintendents, and members of a board of education are assessed. The school is treated both as a bureaucratic organization and as a social setting for the informal interaction of personnel. Questions and issues dealing with innovative forms of organization such as the open-classroom are analyzed and evaluated. Prerequisites: Limited to majors in Education or permission of the Dean. Phelan.

01-383 EDUCATION AND SOCIAL INEQUALITY

(3,0)3

Recent attempts to equalize educational opportunities are assessed with major emphasis upon differences in social backgrounds on students, social composition of schools and school systems, effects of preschool socialization, educational and occupational aspirations of students, and opportunities for social status and mobility in American society. Prerequisites: Limited to majors in Education or permission of the Dean. Phelan.

01-384 EDUCATION AND CULTURAL DIVERSITY

(3,0)3

This course is designed to familiarize students with the cultural richness of a multi-ethnic, multi-racial society. Course readings, class discussions and written work are intended to help the future teacher: (1) to isolate opinions and prejudices about the values, norms, and life styles of people having different ethnic, racial, and social class backgrounds, and (2) to avoid and discourage racial, sexual, ethnic, religious, physical and other stereotyping, and (3) be aware of and correct any ethnic, racial or sexual bias. Fulfillment of these objectives will contribute to a future teacher's responsiveness to the individual needs of students so as to enhance their self-esteem. Also, a teacher will be able to develop a learning environment favorable to open inquiry and devoid of ridicule. Phelan.

01-391 PHILOSOPHY OF EDUCATION

I, II(3,0)3

This course will emphasize the philosophical dimensions of education with special emphasis given to the goals of education, the notion of the person in social context and the structure of knowing. Prerequisites: Limited to majors in Education or permission of the Dean. Lyons.

01-392 PHILOSOPHICAL AND MORAL ISSUES IN EDUCATION

I, II(3,0)3

Several important issues in education will be examined from the standpoint of moral and social philosophy. Topics will include the meaning and purpose of education, the concepts of equality, freedom, authority, and democracy in the school, and the problems of institutional accountability and reform. Readings will be selected from philosophers, educators, and critics of education - past and present. Prerequisites: Limited to majors in Education and permission of the Dean. Wagner.

Teacher Education (Course Prefix: 02)

02-361 READING: ELEMENTARY SCHOOL

I, II(3,0)3

A critical analysis of fundamental issues and principles in the teaching of reading, including all phases of the elementary reading program. Particular attention is given to the assessment and use of a broad range of current materials and approaches designed for diagnostic and developmental teaching of reading. Research in reading and in allied disciplines is evaluated in terms of basic applied values. Corequisites: 02-362, 02-363, 02-364, 02-367. McParland.

02-362 LANGUAGE EDUCATION - ELEMENTARY

(3,0)3

Students in this course in the curriculum and teaching of language will examine the role of communication in the life of the child, the acquisition and development of children's language, and procedures for teaching oral and written communication to children who exhibit linguistic variation. Corequisites: 02-361, 02-363, 02-364, 02-367. Kiernan.

02-363 MATHEMATICS: ELEMENTARY SCHOOL

I, II(3,0)3

Analyzes new approaches in the curriculum and teaching of mathematics in the elementary school with emphasis on the examination of concepts which are most appropriate for the development of mathematics curricula for children. Particular attention is given to the analysis and use of current materials, multimedia approaches, and inductive and problem-solving techniques. Corequisites: 02-361, 02-362, 02-364, 02-367. Demogenes.

02-364 ANALYSIS OF TEACHING

(3,0)3

The course presents practical processes for instructional designs. Those are based on the psychology of learning carried out with the concept of systems approach. The major classifications of learning outcomes are introduced and are interrelated with clearly defined performance objectives, teaching strategies, and evaluation techniques. Major emphasis is given to developing the individual lesson plan. Classroom management and control is a topic given critical attention throughout the course. Corequisites: 02-361, 02-362, 02-363, 02-367. Commito.

02-367 FIELD-BASED PRE-PRACTICUM

(0,0)0

This course involves substantial field-based training experience in preparation for the practicum in teaching. Corequisites: 02-361, 02-362, 02-363, 02-364. Staff.

02-368 SOCIAL STUDIES AND SCIENCE

(3,0)3

This course will examine the conceptual approaches to the selection and organization of context for the teaching of the social sciences as well as analyze new approaches in the curriculum and teaching of science in the elementary school. Major emphasis will be given to the examination and evaluation of theories and strategies used in new programs, use of current materials, multimedia approaches, inductive and problem-solving techniques, and the use of procedures to encourage thinking, discovering and creativity. Prerequisites: 02-361, 02-362, 02-363, 02-367. Corequisites: 02-460, 02-462.

02-460 SEMINAR I

(1,0)1

An introduction to the profession through discussion of the purpose of student teaching, evaluation of student teaching, classroom management and control, the role of the public schools in teacher education, relationship of student teachers with cooperating practitioners, principals, and other teachers in the school, specialists and parents. A case study approach is used for developing skills in conducting parent conferences. Prerequisites: 02-361, 02-362, 02-363, 02-364, 02-367. Corequisites: 02-368, 02-462.

02-461 SEMINAR II

(1,0)1

Topics such as professional salary and contract responsibilities and negotiations, preparation of a resume, interviewing techniques and placement, media and technology, the role of the community in public education, and public education in a culturally diverse society will be discussed in this continuation of the seminar in elementary education. Prerequisites: 02-361, 02-362, 02-363, 02-364, 02-367, 02-368, 02-460, 02-462. Corequisites: 02-463, 02-481, 02-483.

02-462 TEACHING: ELEMENTARY EDUCATION I

(6,0)6

Full-time student teaching for an eight week period in the public elementary schools under the supervision of qualified cooperating practitioners, principals, and faculty of the College of Education. Provides experience for the student in applying and extending his knowledge and ability in teaching. Prerequisites: 02-361, 02-362, 02-363, 02-364, 02-367. Corequisites: 02-368, 02-460. Staff.

02-463 TEACHING: ELEMENTARY EDUCATION II**(6,0)6**

Full-time student teaching for a ten week period in the public elementary schools under the supervision of qualified cooperating practitioners, principals, and faculty of the College of Education. Provides experience for the student in applying and extending his knowledge and ability in teaching. Prerequisites: 02-361, 02-362, 02-363, 02-364, 02-367, 02-368, 02-460. Corequisites: 02-461, 02-481, 02-483. Staff.

02-481 READING DISABILITIES**(3,0)3**

An advanced course in the analysis and remediation of reading disabilities which will explore the use of critical diagnostic tools and specialized materials with specific emphasis upon the diagnostic-prescriptive method of teaching. The course will also examine the problem of dialectical differences and the special reading problems of youngsters where English is a second language. Prerequisite: 02-361. McParland.

02-483 LITERATURE AND CHILDREN**(3,0)3**

Participants in this course will, by using books and other media, engage in an in-depth study of assorted genre of literature, and they will take steps in the development of a literature program integrated with a variety of curriculum areas for elementary-school-aged children in a multi-ethnic multi-cultural environment. Kiernan.

02-496 PRACTICUM EXPERIENCE**I, II(3,0)3**

A program of campus and/or off-campus experiences which are developed by the student in consultation with a member of the student's major department. Specific requirements will vary, depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem-solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of 9 s.h. Students will be graded "satisfactory" or "unsatisfactory". The practicum experience may not be substituted for a required course in the major. Prerequisite: Permission of the Dean.

FACULTY OF THE COLLEGE OF EDUCATION**Center for Reading and Language**

Dr. Anne M. McParland, Coordinator
Dr. Thomas G. Devine
Ms. Alice G. Kiernan
Dr. Olive S. Niles

Center for the Study of Curriculum and Instruction

Dr. John J. Catallozzi, Coordinator
Dr. Norman F. Benson
Dr. Ado Comito
Mrs. Penelope Z. Demogenes

Center for Administration, Planning and Policy

Dr. Dorothy V. Meyer, Coordinator
Dr. Douglas H. Adamson
Dr. Richard G. Lyons
Dr. William T. Phelan
Dr. Robert B. Wagner

Academic Standards and Admissions Committee (Undergraduate)

Mrs. Penelope Z. Demogenes, Chairman
Dr. John J. Catallozzi
Ms. Alice G. Kiernan

Office of Field Services

Mrs. Penelope Z. Demogenes, Coordinator
Dr. M. Virginia Biggy

FACULTY OF THE COLLEGE OF EDUCATION**DEAN OF THE COLLEGE**

M. Virginia Biggy, B.S., Ed.M., Ed.D.

CHAIRMAN OF THE FACULTY

Norman F. Benson, B.S., A.M., Ed.D.

COORDINATORS OF CENTERS

Anne M. McParland, B.S., Ed.M., C.A.G.S., Ed.D.; Center for Reading Language.
John J. Catallozzi, B.S., Ed.M., Ed.D.; Center for the Study of Curriculum and Instruction.
Dorothy V. Meyer, A.B., Ed.M., Ed.D.; Center for Administration, Planning, and Policy.

DISTINGUISHED VISITING PROFESSOR

Olive S. Niles, Distinguished Visiting Professor, Reading and Language Education; A.B., Mount Holyoke College; A.M., Bryn Mawr College; Ed.D., Boston University.

RESIDENT FACULTY

Douglas H. Adamson, Assistant Professor, Educational Administration; A.B., Yale University; M. Div., J.D., Ed.D., Harvard University.

Norman F. Benson, Associate Professor, Social Science Education; B.S., A.M., University of Minnesota; Ed.D., Ball State University.

M. Virginia Biggy, Professor, Curriculum and Instruction; B.S., Ed.M., Ed.D., Boston University.

John J. Catallozzi, Associate Professor, Educational Psychology; B.S., University of Lowell; Ed.M., Ed.D., Boston University.

Penelope Z. Demogenes, Associate Professor, Mathematics Education; B.S., University of Lowell; Ed.M., C.A.G.S., Boston University.

Thomas G. Devine, Professor, Reading and Language Education; A.B., A.M., Ed.D., Boston University.

Alice G. Kiernan, Associate Professor, Reading and Language Education; B.S., University of Lowell; Ed.M., Boston University.

Richard G. Lyons, Professor, Educational Philosophy; B.S., Ed.M., Ph.D., Boston University.

Mary E. McGauvran, Professor, Measurement and Evaluation; B.S.Ed., Lowell State College; Ed.M., Ed.D., Boston University.

Anne M. McParland, Associate Professor, Reading and Language Education B.S., University of Lowell; C.A.S., Harvard University; Ed.M., Ed.D., Boston University.

Dorothy V. Meyer, Associate Professor, Educational Administration; A.B., Houghton College; Ed.M., Ed.D., Boston University.

William T. Phelan, Associate Professor, Educational Sociology; A.B., Boston College; A.M., Catholic University; Ph.D., University of Chicago.

Margaret R. Shannon, Dean and Professor Emerita, Reading and Language Education; B.S., University of Lowell; Ed.M., Ed.D., Harvard University.

Robert B. Wagner, Associate Professor, Educational Philosophy; B.S., Ohio State University; A.M., Kent State University; Ed.D., Harvard University.

ADJUNCT FACULTY

Ado Commito, Curriculum and Instruction; B.S., Ed.M., Ed.D., Boston University.

VISITING LECTURERS

Dorothy M. Kron, Reading and Language Education; B.S., Framingham State College; Ed.M., C.A.G.S., Boston University.

Lisanio R. Orlandi, Measurement and Research; B.S., Ed.M., Boston University; Ph.D., Boston College.

Eugene F. Trainor, Science and Social Studies Education; B.S., Worcester State College; Ed.M., Boston University; Ph.D., Boston College.

COLLEGE OF ENGINEERING

Aldo Crugnola, Dean

Assistant to the Dean for Academic and External Affairs: William Kyros

Assistant to the Dean for Technology and Continuing Education: J. Robert A. Lemieux

Assistant to the Dean for Research and Graduate Studies: John A. McElman

Assistant to the Dean for Facilities and Planning: Kenneth L. Rodgers.

Broadly defined, engineering is a profession which is concerned with the application of scientific knowledge in the development of technology for the improvement of society.

The engineer is involved in the identification of societal needs, the definition of technological problems which address these needs, and the solutions to these constraints demanded by society. These constraints are social, political, economic, legal and cultural in nature.

While the College of Engineering recognizes that the engineering needs of society are complex and varied, it also is sensitive to the diverse interests, motivations, competencies, and backgrounds of the students. Therefore, the College of Engineering has developed a broad spectrum of programs that serve to involve the interwoven needs of society, the student and the high technology industrial sector of Massachusetts. Although the emphasis within each engineering program is technical, utilizing the latest advances in computer technology in the solution of engineering problems, all programs are characterized by a distinguishable breadth that characterize a professional curriculum that graduates engineers who are qualified to meet contemporary demands.

OBJECTIVES OF THE COLLEGE OF ENGINEERING

The objective of the College of Engineering is to prepare men and women for their entrance into the engineering profession so that they become leaders in industry, government, and education.

In view of the wide variety of engineering disciplines and the functions of engineers within these disciplines, programs have been structured to permit students the option of entering the practice of engineering immediately after attainment of an undergraduate degree or to delay entrance until they have attained a graduate degree. Programs are available in a wide variety of engineering disciplines to accommodate the interests of students. In addition, within each discipline, students may prepare for various engineering functions such as; research, development, design, production, construction, teaching and management. Because of varying student aptitudes for and interest in different aspects of an engineering program, e.g., research, faculty advisors are assigned to each student to provide experienced guidance in selecting programs, courses, and in career planning. Thus, each student is encouraged to develop to his or her full potential as an engineer, with a high degree of awareness of the technological needs of society, the nation and particularly those of Massachusetts industry, government and educational institutions.

The College stresses regional needs by continuously updating elective courses and options in the standard engineering programs and in selected specialty programs. The departments continually advance the level of excellence of their programs. These levels are monitored by means of accreditation standards of the Accreditation Board of Engineering and Technology (ABET) and the National Association for Industrial Technology (NAIT). Departments also adhere to the tenets of the Society of Professional Engineers. The College also follows the career progress of successful graduates and solicits their views as to how programs can be made more effective.

In each discipline, the College of Engineering offers graduate and research programs which are a source of updating the undergraduate course offerings, and ensure that faculty are on the cutting edge of their particular discipline. Programs such as these advance the general level of information and knowledge that is so essential in fast-moving technological fields. They additionally provide the highly specialized advanced-degree studies that industry requires.

The College supports a continuing education program of evening and summer school classes. Continuing Education provides men and women an opportunity at the associate, undergraduate and graduate degree levels to develop in their profession.

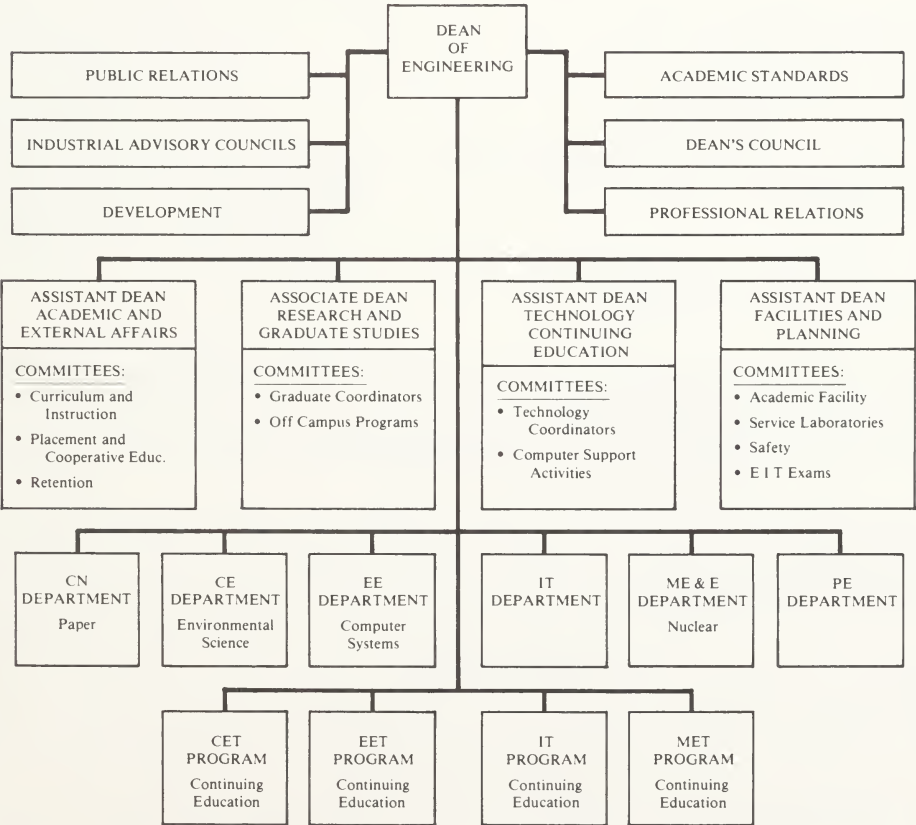
By functioning as an educational resource to the engineering profession and industry of the Commonwealth through instruction, consulting services, and research, the College of Engineering at the University of Lowell is dedicated to providing its students with an ever-current view of the working world for which they are preparing.

COLLEGE ORGANIZATION AND GOVERNANCE

The College of Engineering is organized into six departments and is administered by the Dean of Engineering. As the chief academic and executive officer, it is the Dean's responsibility to formulate goals and objectives for the College within the context of the University mission and to implement programs of high academic standards to attain these goals. The Dean is supported by four assistants in the areas of academic and external affairs; research and graduate studies; technology and continuing education programs; and facilities and planning. An Academic Standards Committee and an Industrial Advisory Council support the College and the departments in monitoring academic standards and in the developing state-of-the-art professional curricula.

The six departments of the College are: Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Technology, Mechanical and Energy Engineering, and Plastics Engineering. While these departments provide a convenient basis for the administration of the College, they share common interests in terms of particular engineering, scientific and liberal arts disciplines which constitute their respective curriculums. Therefore, although students are required to declare their majors by department, they are also required to take courses in several departments both within and outside of the College.

ORGANIZATION CHART



Each department is administered by a chairperson. Each department is responsible for developing its own course offerings and programs of study and the engineering faculty as a whole is responsible for all academic policies of the College.

Academic Standards Committee

The Academic Standards Committee, made up of faculty members, usually chairpersons representing each department, is responsible for enforcing academic standards of the College and establishing and enforcing disciplinary procedures. This committee also serves as a review body for suspended students seeking readmission to the College.

Frank Alberti, Industrial Technology
Roger Baumann, Electrical Engineering, Chairperson
Aldo M. Crugnola, Dean
Norwood Keeney, Jr., Chemical Engineering
Zelman Kamien, Mechanical Engineering

William Kyros, Assistant Dean
Donald Leitch, Civil Engineering
F. Ross Holmstrom, Electrical Engineering
Nick R. Schott, Plastics Engineering

Industrial Advisory Councils

Advisory councils composed of industrial leaders and practicing engineers advise the College and the departments in the formulation of new curricula and in the revision of existing programs in changing areas of high technology. These committees promote a high degree of interaction between the College and the industry which it serves.

College of Engineering

John Connolly, Vice President, Tau-Tron, Inc.
Walter Flinn, Western Electric
William Flood, Kennecott Copper Co.
John C. Lavalley, Vice President, Century Banks
Austin Mason, President, Ludlow Corp.
Ralph L. Mondano, Operations Manager, 3M Co.
Andrew Owens, Dir. of Training, Raytheon Co.
J. Harry Parker, Dir. of Operations, Cullinan Engineering Co., Inc.
Arthur Pingalore, Dir. of Training, Heald Machine Division, Cinn. Milicron, Inc.
Pauline Riordan, Webber Groton Bio-Industrial Development Corp.
Don Sheehan, Digital Corp.
William Thurston, President, GenRad, Inc.

Chemical Engineering

Philip R. Askman, Vice President, Chas. T. Main Co.
Ralph H. Martin, President, C.H. Dexter & Sons
Austin B. Mason, Chairman, Pres. of Ludlow Corp.
Everett C. Reed, President, Albany International

Civil Engineering

Harl P. Aldrich, President, Haley & Aldrich
John Bethel, Jr., Pres., Bethel, Duncan & O'Rourke, Inc.
Bruce Hanes, Chairman, Civil Eng. Dept. Tufts University
John Jarnis, President, Barnes & Jarnis, Inc.
J. Harry Parker, Dir. of Operations, Survey Division, Cullinan Engineering Company Inc.
Bartlett W. Paulding, Chief Engineering Geologist, Geotechnical Engineering, Inc.
Charles A. J. Theodore, President, Hometech Consultants, Inc.

Electrical Engineering

Joseph F. Alibrandi, Plant Manager, Raytheon Co.
Walter S. Baird, President, Baird-Atomic, Inc.
W. Clare Brooks, Consultant, Andover
Martin Schilling, Project Director, Raytheon Co.
Paul G. Yewell, President, Yewell Associates, Inc.

Industrial Technology

Robert King, Group Supervisor of I.E. Training, GTE Sylvania Products Corp.
Charles Lagasse, President, Plastek Corp.
Allen LeBoeuf, Area Manager, Lawrence Pumps, Inc.
Pamela Orosky, Manufacturing Engineer, Sanders Associates
Richard Phelan, Manager, Manufacturing and Product Engineering, Honeywell Corp.
Arthur Pingalore, Director of Training, Heald Machine Division, Cincinnati Milicron, Inc.
Franco Previd, Manufacturing Engineering Manager, Digital Equipment Corporation
John Siderwitch, Manager, Process and Industrial Engineering, Western Electric Company
John Leahy, Supervisor, Western Electric Company (Alt.)

Mechanical Engineering

James Henshaw, Sr. Staff Engineer, Avco Corp.
Sander Nydick, Program Manager, Thermo Electron Corp.
Eugene Robinson, Vice Pres., Operations, Lowell Gas Co.
George Roehr, President, Roehr Tool Company

Nuclear Engineering

Charles Adey, Supervisory Plant Manager Services Group, Stone & Webster
Sten Caspersson, Project Manager, Fast Breeder Reactor Development, Combustion Engineering
Eric Clarke, Vice Pres., Tech/Ops., Inc.
Keith Dinger, Dir., Radiation Health, Portsmouth Naval Shipyard
Michael Driscoll, Massachusetts Institute of Technology, Associate Professor N.E. Radiation Health
John C. Gart, Physicist (Solid State), U.S. Air Force, Hanscom Field

Plastics Industrial Advisory Committee

Spencer Baba, Manager, Appl. Eng. R&D. Arco Polymers Inc.
Clyde Brenner, Amoco Chemicals Corporation
Thomas J. Conlon, Pres., Contour Chemical Co.
Paul Dalton, Monsanto Company
Joseph Day, C. H. Dexter Company
F. Reed Estabrook, Consultant
Neil T. Flathers, OMYA Incorporated
Robert D. Forger, Exec. Secy., Society of Plastics Engineers, Inc.
Nick Fountas, Plastics World Magazine
Iver J. Freeman, Vice President, Reed-Prentice co.
Michael Gigliotti, Michael Gigliotti & Assoc., Inc.
Howard Koenig, Consultant
Alan Litman, Xerox Corporation
Robert McGee, Gerard Designs
Ralph L. Mondano, Operations Mgr., 3M Company
Ray Narr, General Electric Company
Matthew H. Naitore, Editor, Plastics Technology Magazine
Bruce L. Oliver, Dow Chemical Company
Joohn O'Toole, Allied Chemical Company
David F. Petherbridge, Eastman Kodak Company
Norm Rei, Chemist, Ventron Corporation
Roger Rhoads, Section Chief, Owens Illinois
Joseph Rich, Mobay Chemical Company
Domenic V. Rosato, U. Lowell, Cont., Ed. Seminars
E. M. Smolin, Manager, Plastics Materials Div., Amp. Inc.
Albert Spaak, Exec. Director, Plastics Institute of America
Thomas L. Vieira, Supervisor, Eastman Kodak Company
Stephen Vitkovits, Eng. Mgr., Hewlett-Packard
Ronald P. Weston, Tech. Dir., The Gillette Company
James Zimmerman, Manager, Ford Motor Company

Baccalaureate Degree Programs

The College of Engineering offers four-year undergraduate programs leading to the degree of Bachelor of Science in Engineering and Bachelor of Science in Technology; five-year dual degree programs with the College of Liberal Arts leading to a Bachelor of Science degree in Engineering and a Bachelor of Arts Degree simultaneously; five-year programs leading to both Bachelor of Science and Master of Science degrees simultaneously.

The degree of Bachelor of Science in Engineering is offered in the following fields: Chemical Engineering (a Paper Engineering option is available in the senior year), Civil Engineering, Electrical Engineering, Mechanical Engineering, Nuclear Engineering, and Plastics Engineering. Course requirements for engineering degrees have been determined by specific professional objectives and are subject to the recommendations of the Accreditation Board for Engineering and Technology (ABET). The degree of Bachelor of Science in Technology is granted to students who pursue and successfully complete the program in Industrial Technology.

This degree, plus degrees in civil, electrical and mechanical engineering technology, are also offered in the evening through the division of Continuing Education. Course requirements for the degree in Industrial Technology are subject to the recommendations of the National Association for Industrial Technology (NAIT). Degrees in engineering technology are accredited by ABET.

Courses of study in both engineering and technology provide a basic general education, scientific-technological training in the sciences and a comprehensive introduction to an engineering or technology field. Students must

select a single engineering or technology field as a major field of study which is specified in terms of the total curriculum and without reference to major and minor options which are available in Bachelor of Arts and other Bachelor of Science degree programs. However, candidates for degrees in the College of Engineering are permitted to elect additional majors in other colleges of the University, provided that all curriculum requirements in engineering or technology are satisfied.

Baccalaureate Options

Cooperative Education Program (4-year plan)

The Cooperative Education Program for undergraduates combines academic studies with productive work experience in pertinent industry and business settings. It permits students to participate in an alternating schedule of study and work that is related to the student's academic field of study and to receive academic credit for the work experience.

The College of Engineering is a full participant in the Cooperative Education Program. All Engineering and Technology student may participate in this program which enables a student to work in industry and to complete a baccalaureate program in four years.

Dual Degree Program BS/BA

The College of Engineering and the College of Liberal Arts offer a five (5) year dual degree program which permits the student to earn a BS degree in a designated engineering field (plastics, mechanical, civil and chemical) while simultaneously earning a BA degree in one of the following areas of liberal arts: American studies, art, English, languages, history, political science, philosophy, psychology or sociology.

Students entering the dual degree program must meet the entrance requirements of both colleges and must complete the University core requirement. Curricula for dual degree programs are approved by the faculties of the participating colleges and must be completed as prescribed. It is imperative that students entering the Engineering/Liberal Arts dual degree program refer to the specific requirements of the appropriate Engineering and Liberal Arts curricula which are found in this bulletin. Further information on these curricula is available from the Dean of the College of Engineering or from the Dean of the College of Liberal Arts. Both the Bachelor of Arts (AB) and the Bachelor of Science in Engineering (BS) degrees are conferred at the end of the fifth year. The conferral of the Bachelor of Arts degree is contingent upon the completion of all the requirements for the degree of Bachelor of Science in Engineering.

Dual Degree Program with Other Colleges (3 + 2 plan)

A formal "3 + 2" cooperative engineering program is jointly offered by St. Anselm College and the University of Lowell. This program enables a student to gain both a liberal arts education and a professional engineering education by earning a bachelor of arts degree from St. Anselm and a bachelor of science degree in engineering from the University of Lowell. Students in this program will enter St. Anselm and study for three years, gaining a broad liberal arts training combined with a number of pre-engineering courses. The student then enrolls at Lowell for two additional years, completing a professional engineering program.

Combined BS/MS Degrees Program (5-year plan)

In order to encourage outstanding undergraduate students to continue their studies toward an advanced degree, the College of Engineering and the Graduate School offer a program of accelerated study which leads to a Master of Science degree.

To be eligible to enter this course of study, a student must file a formal Graduate School application in the junior year. Application does not require the student to take a graduate entrance test or the Graduate Record Examination. Upon recommendation by the student's advisor and with the approval of the departmental Graduate Admissions Committee and of the Dean of the Graduate School, the student may be admitted to graduate study dur-

ing the second semester of the senior year. At this time the student becomes a provisional Graduate Student. A Master of Science degree normally requires 32 credits beyond the bachelor's degree, except as provided in the following paragraph.

Certain credits earned in the senior year at the advanced undergraduate level ("400" level courses) and in graduate level courses may be used to satisfy requirements for both the undergraduate and graduate degrees. The University specifies a minimum of 120 course credits for a baccalaureate degree. Credit for courses taken in senior year which are applicable to the MS degree must be credits earned in excess of the number of credits specified (120) for the BS degree. In such a case, the senior student, with the necessary approval, may transfer up to 9 credits (the maximum number permitted) toward the graduate degree of Master of Science in Engineering. A department reserves the right to require a student to take additional courses beyond the specified minimum for the M.S. degree and individual departments have the option of requiring students to do a thesis. All students must fulfill all departmental and graduate school requirements for the M.S. degree.

A student taking full advantage of the combined program may expect to finish degree work for the M.S. at the end of the fifth year of study. Actual completion will depend on the student's course load and thesis work. Students in this program are eligible for financial assistance, i.e., fellowships and teaching assistantships, during the fifth year of study, but are advised that this may delay completion of the program.

GENERAL COLLEGE REQUIREMENTS

Each candidate for an undergraduate degree must satisfy the general requirements of the University of Lowell in order to graduate. The student must also meet the specific academic requirements of the College of Engineering as indicated in this section as well as complete all credits and courses required by the department in which the student majors. The number of credits required for the completion of College of Engineering curricula is established by the several departments.

Students who wish to enter the College of Engineering as freshmen, (except for those enrolling in the Industrial Technology program) must achieve Scholastic Aptitude Test (SAT) scores of at least a 400 in the verbal segment and a 500 in Mathematics. For those students enrolling in the Industrial Technology program, the required SAT scores are 400 in verbal and 450 in mathematics.

While students enrolled in the Industrial Technology and Mechanical Engineering Departments take freshman year course programs tailored to the special interests of those fields, all other freshmen students in the College of Engineering pursue a common program during the first year. First year students take collateral courses such as College Writing I and II and Economics I, together with basic courses in science and mathematics.

An additional requirement for all students in the freshman year is a one credit orientation course "Perspectives in Engineering." This course is designed to introduce the freshman to the engineering profession and to help the student make an informed decision about the selection of a major field of study for which he or she is best suited. The course consists of lectures, demonstrations, case studies, problems, field trips, and discussions about the fields of engineering. Faculty members from each department in the college present aspects of their own fields. Discussion ranges from curricular requirements and the academic demands of the programs to realistic appraisals of career opportunities. During the course each student receives individual counselling from a faculty advisor.

Students who have completed their freshman program with a grade-point average of 2.50 or better, automatically qualify for admission to the sophomore program level. Students who fail to achieve that required average will be admitted to the sophomore year of engineering programs only upon the recommendation of appropriate departmental committees and the Academic Standards Committee of the College of Engineering. In addition to satisfying University retention and graduation requirements, each candidate for a degree in the College of Engineering must achieve the following grade-point averages in departmentally designated subjects to satisfy College retention and graduation requirement: 1.70 (end of the sophomore year: 60 hours completed), 1.90 (end of the junior year: 90 course hours completed), and 2.00 (graduation). Students who fail to achieve the specified sophomore or junior year average in departmentally designated subjects have not made satisfactory progress toward their degrees and will be dismissed from the College for inadequate scholarship unless they have been granted continued matriculation status by their department and the Academic Standards Committee of the College.

Individuals who fail to satisfy retention requirements may petition for continued matriculation status, by filing an

academic petition with their department chairperson. Individuals who are not granted continued matriculation in the College of Engineering and who satisfy University retention requirements may file for intercollegiate transfer within the University. Students who are dropped from the College of Engineering but who are ineligible to file for intercollegiate transfer or who are denied admission to another college following application for intercollegiate transfer are dropped from the University.

Major Field of Study

Declaration of Major Program

Students who are enrolled in the College of Engineering are committed to pursue one of the established degree-granting programs. They are, therefore, required to make an initial declaration of a degree major (course of study) upon enrollment.

A student who wishes to elect an additional major which is offered by another college within the University of Lowell, is a candidate only for a degree in the College of Engineering.

Thus, a student who declares major in addition to engineering is subject to the major course requirements specified by the department offering the additional or second major. The selection of the second major does not entitle the student to be a candidate for a degree in the area of the additional major. University policies relevant to this topic appear elsewhere in the general catalog under the heading: "University Academic Policies: Major Field Requirements." Also, students who are interested in satisfying degree requirements in both the College of Engineering and another college within the University should inquire if dual programs can be authorized. Currently such a dual degree program is authorized only for students matriculating in the College of Engineering and the College of Liberal Arts.

Declaration of Second Major

Candidates for degrees in the College of Engineering may be permitted to elect additional majors offered in other colleges of the University—provided that all curriculum requirements in Engineering or Industrial Technology will be satisfied.

Engineering students who wish to take on a second major which is offered by another college must formalize this intent by the start of the junior year. At that time the student is required to submit for approval a program of study to an advisor in the department offering the second major. The study program must be accepted by that non-engineering college.

When a student earns a second major, an entry is made on the official transcript, but does not appear on the diploma. It should be noted that for all but the unusual student, the election of additional majors will mean extension of the normal four-year period of undergraduate study. (Refer to "University Academic Policies: Declaration of Second Major").

Change of Major

Students who wish to change their declarations of major within the College of Engineering are required to follow the procedure stipulated in the bulletin under "University Academic Policies: Change of Major within College of Enrollment." It should be noted that College of Engineering students who change their programs within the College of Engineering after the first semester of the junior year may expect to complete additional credits work beyond the minimum degree requirement, and, furthermore, may extend the normal four-year period of study.

Students who wish to change their Engineering or Industrial Technology major and wish to select a major which is offered by another college within the University of Lowell, must apply for an "intercollegiate transfer", which is described under "University Academic Policies: Change of Major with Intercollegiate transfer".

Qualified students from other colleges in the University of Lowell may transfer into degree programs of the College of Engineering using the same procedure. However, these students may expect to extend their period of study beyond the normal four-year period, particularly if they transfer after the first semester of the sophomore year.

Transfer Policies of the College of Engineering

It is the policy of the College of Engineering to accept transfer students from other institutions as well as from other colleges within the University of Lowell. Such transferring students may expect recognition of previously completed courses if these are equivalent to those which are specified by the curricula of the College of Engineering.

Transfers from Other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University of Lowell requirements when a student is admitted to the University. Professional courses are subsequently evaluated by the departments in which the student has been accepted. Credit is given for completed courses where the grade is "C" (2.0 on a 4.0 scale) or better.

The University of Lowell has subscribed to the Massachusetts Transfer Compact. Under this Compact, the holder of an associate degree from a Massachusetts Community College receives 60 credits for this work toward a Bachelor of Science in engineering or technology. For such students, the grade-point average computation is started fresh. Students wishing to transfer who have not earned an associate degree are required to have at least a 2.5 grade-point average in order to be admitted to the College of Engineering.

Courses which are transferred to the University of Lowell under the provisions of the Massachusetts Transfer Compact, but which do not meet the credit requirements of the College of Engineering, or which are not acceptable as unrestricted elective courses, will be listed on the student's permanent record card, but will not apply to the minimum degree requirements.

The policies of each of the colleges in the University determine how grades received in transferred courses apply in determining the grade-point average of the student's major at the University of Lowell. It is the policy of the College of Engineering not to count such grades for the purpose of determining the student's grade-point average in his or her professional area.

In the event that a student who has first transferred to some other college in the University of Lowell under the Massachusetts Transfer Compact and subsequently makes a transfer to the College of Engineering, all previously completed courses, including transferred courses from other Compact institutions, will be re-evaluated in terms of their applicability toward degree requirements of the College of Engineering.

Repetition of Transferred Courses

A student who has been granted transfer credit from another institution, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be subsequently advised to repeat such transferred work at the University of Lowell. Such cases arise when the competence of the student is demonstrably inadequate for the College of Engineering. These students may be advised to take a replacement course, similar to that which had been taken at the previous institution and which was transferred in order to improve the student's ability to function at an acceptable academic level.

To repeat a transferred course a student must file an academic petition form through the office of the College Dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a "request to revoke recognition" to delete the previously transferred course credit from the student's cumulative grade-point average.

Intercollegiate Transfer to the College of Engineering

Students wishing to transfer to the College of Engineering from another college of the University or from a baccalaureate Continuing Education program must file a declaration of Major form (if they are seeking transfer from another college) or an academic petition (if they are seeking transfer from a Continuing Education program) together with a current transcript with both the Dean of the College of Engineering and with the chairperson of the appropriate engineering department.

Petitions for transfer must be filed no later than November 1 in order to transfer in the spring semester, and no later than April 1 in order to transfer in the fall semester.

Any student who wishes to transfer from another college in the University to the College of Engineering must have a minimum grade-point average of 2.50. Records of students who are approved for transfer are reviewed by the Office of the Dean. Irrespective of grades received, all courses which may not be applied to the College of Engineering program requirements will be deleted from the student's cumulative grade-point average.

For further details about the University's policies concerning intercollegiate transfer, students should read the section which appears elsewhere in the general bulletin entitled; "University Academic Policies: Change of Major with Intercollegiate Transfer."

DEPARTMENT OF CHEMICAL ENGINEERING

Chairperson: Norwood H. Keeney, Jr.

Professors: Ning H. Chen, Charles J. Higgins, Norwood H. Keeney, Jr.

Associate Professors: Alfred A. Donatelli, Huan-Yang, James A. Mann, Dominick A. Sama, Karl J. Sladek, John W. Walkinshaw.

Chemical Engineering is an engineering discipline broadly based on the Science of Chemistry. It is a discipline which is concerned with chemical reactions, reaction kinetics, equilibria, and mass and energy transport.

The basic concepts of unit operations and unit processes which were originally developed by Chemical Engineers, have proved to be effective over a wide range of applications. Thus, Chemical Engineers traditionally have entered into all phases of chemically oriented business and industry. In recent times, they have been moving into such fields as bio-chemical engineering, enzyme engineering, environmental protection, petrochemicals and polymer science, as well as into specialties such as administration, management and patent law.

The chemical process industry and such allied industries as paper, plastics, packaging, pharmaceuticals and materials sciences assure a strong and continuing growth field for Chemical Engineers. Thus, the broad chemical and engineering training which is provided by the Chemical Engineering curriculum at the University of Lowell qualifies graduates for careers in product or process development, production operations and research and development; also in sales, marketing and general management.

The stability and dynamic growth of the paper industry has opened unparalleled challenges for the graduate trained in Chemical Engineering. Accordingly, the Department offers the interested student an opportunity to elect a block of technical electives during the senior year which constitutes an option in Paper Engineering. Several scholarships (\$500 per year) are available to students who elect this option.

Chemical Engineering Program

The Chemical Engineering curriculum, which is accredited by the Accreditation Board for Engineering and Technology (ABET), provides maximum flexibility to students, allowing the individual student to also do original research work. Considerable emphasis is placed on oral and written reports to provide students the necessary experience which is needed in the business world where such reports are an important part of a Chemical Engineer's work.

A variety of support is provided for students in Chemical Engineering to enhance their professional development. A number of scholarships (\$500 per year) are available to deserving students. Undergraduates are encouraged to gain practical experience and are directed to summer employment in the chemical or paper industries. The Department also encourages students to take the E.I.T. examinations in order to qualify as Registered Professional Engineers following graduation. In addition, students have the opportunity to join the student chapter of the American Institute of Chemical Engineers and/or the student chapter of the Technical Association of the Pulp and Paper Industry. A local chapter of the Chemical Engineering Honor Society, Omega Chi Epsilon, is open to qualified students.

COURSE OF STUDY FOR CHEMICAL ENGINEERING#

Freshman Year

Fall Semester

- 00-101 Perspectives in Eng.
 - *84-121 Chemistry
 - *84-123 Chem Lab.
 - 42-101 Coll. Writing
 - 92-131 Calculus B-I
- or

Spring Semester

- | | | |
|---|---------------------------|---|
| 1 | | |
| 3 | *84-126 Chemistry | 3 |
| 1 | *84-124 Chem. Lab. | 1 |
| 3 | 42-102 Coll. Writ. & Lit. | 3 |
| | 92-132 Calculus B-II | |
| | or | |

92-133 Calculus A-I	4	92-134 Calculus A-II	4
95-141 Intro. Physics	3	*95-144 Fund. Phys. I	3
*96-141 Fund. Exp. Phys. I	1	+ 96-144 Fund. Exp. Phys. II	1
Physical Ed.		Physical Ed.	
	16		15
*84-135 Honors Chem & 84-137		*84-136 Honors Chem. & 84-138	
Honors Chem. Lab.,		Honors Chem. Lab.	
*95-147 Honors Phys. & 96-147		*95-148 Honors Phys. & 96-118	
Fund. Exp. Phys. I may be substituted		Fund. Exp. Phys. II may be substituted	

Sophomore Year

Fall Semester		Spring Semester	
84-221 Organic Chem.	3	84-222 Organic Chem.	3
84-229 Org. Chem Lab.	1	84-230 Org. Chem Lab.	1
10-203 Chem. Eng. Calc. I	3	10-204 Chem. Eng. Calc. II	3
*10-207 Computer Prog. CN	2	*10-206 Fluid Mechanics	2
92-231 Calculus B-III		92-232 Calculus B-IV	
or		or	
92-231 Calculus A-III	3	92-234 Calculus A-IV	3
22-201 Graphics	1	14-216 Anal. Mech. II	3
14-215 Anal. Mech. I	3	64-202 Economics II	3
64-201 Economics I	3		
	19-20		18-19

Junior Year

Fall Semester		Spring Semester	
10-305 Heat Transfer	3	*84-345 Phys. Chem. II	3
10-311 Chem. Eng. Thermodyn.	3	*84-347 Phys. Chem. Lab. II	1
10-315 Unit Opn. Lab. I	1	10-306 Transport Phenom.	3
92-317 Appl. Math. Chem. Eng	3	10-308 Eng. Materials	3
*84-324 Prin. Anal. Chem.	3	10-310 Sep. Processes	3
*84-325 Prin. Anal. Chem. Lab.	1	10-316 Unit Opn. Lab. II	1
Human. Soc. Elective	3	16-350 Industrial Elec.	3
	17		17

*Offered both semesters.

Senior Year

Fall Semester		Spring Semester	
10 10-403 Reac. Design & Kine.	3	10-410 Plant Design	3
10-409 Econ. & Proc. Anal.	3	10-416 Proc. Dyn. & Control Lab	2
10-413 Proc. Dyn. & Control	3	*Tech. Elect.	3
Undesignated Elect.	3	+ Undesignated Elect.	3
Human. Soc. Elect.	3	Human. Soc. Elect.	3
	18	Human. Soc. Elect.	3
			17

#Core requirements will differ for numbers of the graduating class of 1987 and subsequent classes.

*In Chemical Engineering

+ ROTC Students may elect 29-401.

+ ROTC Students may elect 29-402, in lieu of ROTC, technical elective from the Colleges of Engineering and/or Pure & Applied Science required.

Students electing the option in Paper Engineering will take the following courses in their senior year as an undesignated electives:

10-402 Eng. Anal. of Coating & Converting Systems	3
10-405 Design of Papers	4
10-501 Paper Industry Process Analysis	3
10-504 Process Calcs. of Pulp & Paper Processes	3

The Five Year BS/MS Program

The Department of Chemical Engineering offers a 5-year BS/MS program in Chemical Engineering and Paper Engineering. An undergraduate student electing this program may utilize the program's technical electives to partially satisfy the course requirements of the Master of Science degree program. A student wishing to elect this BS/MS program must notify the Department Chairperson during the junior year. On acceptance by the committee, he or she must make a formal application to the University Graduate School. Students who are accepted into this 5-year BS/MS program are also eligible for consideration as Teaching Assistants during their fifth year.

Chemical Engineering (Course Prefix: 10)

10-203 CHEMICAL ENGINEERING CALCULATIONS I

I(3-0)3

Introduction to the field of chemical engineering and the solution of problems involving units and dimensions, mass balances, flow sheets and gas relationships. Prerequisite: 84-126 or 84-136.

10-204 CHEMICAL ENGINEERING CALCULATIONS II

II(3-0)3

Continuation of Introduction to Chemical Engineering Calculations including real gas relationships, humidity, energy balances, and the combined mass-energy balance systems. Prerequisite: 10-203.

10-206 FLUID MECHANICS

I,II(2-0)2

Introduction to fluid statics and application of fluid mechanics principles to the analysis and design of fluid systems. Design of fluid meters and conduits. Friction factor, pressure drops in laminar and turbulent flow and the introduction to boundary layer theory.

10-207 COMPUTER PROGRAMMING FOR CHEMICAL ENGINEERS

I,II(1-2)2

Introduction to FORTRAN IV programming, statements, control, Do loop and subscripted variables, functions and subroutines, input and output. Emphasis is placed on FORTRAN application to chemical engineering problems, selected numerical methods. Six to eight problems will be individually handled by each student on the University computer facilities.

10-305 HEAT TRANSFER

I(3-0)3

Fundamental principles of heat transmission by conduction, convection, radiation and evaporation. Applications of these principles to the solution of industrial heat transfer problems and to the preliminary design of heat exchange equipment including evaporators. Prerequisites: 10-204, 10-206.

10-306 TRANSPORT PHENOMENA

I(3-0)3

Introduction to the theory of momentum, energy and mass transfer. Integral and differential approaches. Macroscopic and microscopic balances. Application of the conservation laws to the solution of practical problems in the chemical industry. Prerequisites: 10-206, 10-305, 92-317.

10-308 ENGINEERING MATERIALS

II(3-0)3

Study of materials for engineering construction and chemical purposes from standpoint of physical and chemical properties, corrosion and introductory electrochemistry. Structures of metals, non-metals and polymeric materials. Structure of materials related to ultimate performance. Prerequisites: 84-222, 22-216, 95-144.

10-310 SEPARATION PROCESSES

II(3-0)3

Introduction to each of the separation processes, distillation, absorption, extraction, and humidification. Material balances and energy balances, mass transfer relations, equilibrium relations. Graphical and numerical methods for solving problems, iterative methods for use with a digital computer. Prerequisites: 10-204, 92-234.

10-311 CHEMICAL ENGINEERING THERMODYNAMICS

I(3-0)3

Development of the First and Second Laws of Thermodynamics. P-V-T relations, mathematics of property changes, generalized correlations of thermodynamic properties, application of thermodynamics to problems of phase and chemical equilibria. Prerequisite: 10-203.

10-315 UNIT OPERATIONS LABORATORY I

I(0-3)1

Experimental projects dealing with fluid flow (4) and heat transfer (1). Written reports required. Prerequisite: 10-206, 10-203. Corequisite: 10-305.

10-316 UNIT OPERATIONS LABORATORY II

II(0-3)1

Experimental projects dealing with heat transfer (3) and mass transfer (1). Written reports required. Prerequisite: 10-315. Corequisite: 10-306.

10-402 ENGINEERING ANALYSIS OF COATING AND CONVERTING SYSTEMS

II(2-3)3

Lectures and problems concerned with the engineering design, technology and economics of paper and paper-board processes. Rheology and engineering properties of coating materials, mechanical processes, coating, impregnating, laminating and printing processes discussed in detail. Prerequisite: 10-401.

10-403 KINETICS AND REACTOR DESIGN

I(3-0)3

Review of principles underlying rates of transformation of matter and energy; effect of temperature and catalysis

on chemical reactions; application to design of chemical reactors; use of digital computers in solution of problems. May be taken for graduate credit. Prerequisites: 10-306, 10-310, 10-311, 84-345, 92-317.

10-405 DESIGN OF PAPERS

I(3-3)4

Fundamentals of the mechanical and optical testing of paper and allied products. Discussion of engineering mechanics involved in various testing procedures. Statistical analysis of test data. Structure of materials revealed by physical tests. Laboratory projects designed to illustrate problems in design of pulps and paper. Prerequisite: Permission of instructor.

10-409 ECONOMICS AND PROCESS ANALYSIS

I(3-0)3

This course brings together all of the Chemical Engineering disciplines into the development of a preliminary plant design. A term paper as a series of group efforts is required together with an oral presentation of the term paper. The term paper presents a preliminary evaluation of the economics, marketing and the preliminary evaluation of a particular product. Lectures emphasize the basic economics and the time value of money as well as the methods of depreciation. Capital and operating costs are emphasized. Term paper on design required. Prerequisite: 10-310.

10-410 CHEMICAL PLANT DESIGN

II(3-0)3

Applications of transport phenomena and separation processes, economics and process analysis in the design of complete chemical plants; optimization of plant equipment. Flow sheets, specifications for equipment and a term paper on an economic estimate of the total plant cost is required for the course. Prerequisites: 10-403, 10-409.

10-413 PROCESS DYNAMICS AND CONTROL

I(3-0)3

An introduction to chemical process control, description of processes and equipment by differential equations and the LaPlace Transform. Development of block diagrams. System Stability is studied by both Root Locus and Frequency Responses methods. May be taken for graduate credit. Prerequisites: 92-317, 10-305, 10-306, 10-310.

10-416 UNIT OPERATIONS LABORATORY III

II(1-3)2

Experimental projects (2) dealing with automatic control applications and mass transfer operations. Written and oral reports required. Prerequisite: 10-413, 10-316.

10-419 SPECIAL SENIOR PROJECTS

CREDITS ARRANGED

Original research projects primarily in the Chemical Engineering field and supervised by a staff member of the Department. Reports required on work done. Prerequisite: Permission of instructor.

10-420 SPECIAL SENIOR PROJECTS

CREDITS ARRANGED

Continuation of 10-419.

10-422 CASE STUDIES IN CHEMICAL ENGINEERING

II(3-0)3

Discussion of a number of chemical engineering processes from the standpoint of engineering theory and reduction to practice. Plant visits will be used to illustrate real-life engineering solutions. Oral and written reports required. Prerequisite: Permission of instructor.

10-424 ANALYSIS OF CHEMICAL PROCESS INDUSTRIES

II(3-0)3

An examination of the chemical process industries showing their interrelationship and interaction with other industries. Process analysis and economics are stressed. Selected processes are studied in detail to illustrate processing problems, alternative raw materials, environmental and marketing problems. A term paper is required. Prerequisite: Permission of instructor.

10-435 POLYMERIZATION PROCESSES

I(3-0)3

An introduction to polymer science and engineering. A study is made of the many types of polymeric materials, on their structure and chemical processing, and on their physical properties and processing into finished products. Prerequisite: Permission of instructor.

10-440 ESTIMATION OF ENGINEERING PROPERTIES

II(3-0)3

Discussion of currently available methods of estimation of physiochemical properties, analysis of published experimental data, curve fitting and nomography, interpolation and extrapolation of data, statistical and numerical methods, dimensional analysis. Prerequisite: Permission of instructor.

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

10-501 PAPER INDUSTRY PROCESS ANALYSIS I(3-0)3
Lectures dealing with processes of fiber separation from raw materials, fiber purification, mechanical processing of fiber and sheet formation. Chemical Engineering theory is applied to the analysis of these operations. Prerequisite: Permission of instructor.

10-503 MASS TRANSFER OPERATIONS I I(3-0)3
Detailed coverage of the fundamentals of separation processes of absorption and extraction. Degrees of freedom, phase equilibrium diagrams, graphical techniques. Molecular diffusion, interphase mass transfer, mass transfer and simultaneous chemical reaction. Design principles for multistage countercurrent contactors and continuous differential-contact columns. Prerequisite: Permission of instructor.

10-504 PROCESS CALCULATIONS OF PULP AND PAPER PROCESSES II(3-0)3
Mathematical analysis of various processes involved in the pulping of wood and the manufacture of paper. Typical mass and energy balances in conjunction with fluid flow. Heat transfer and mass transfer calculations are used to analyze the operations. Prerequisites: 10-305, 10-310.

10-506 COLLOID CHEMISTRY FOR CHEMICAL ENGINEERS II(3-0)3
Colloid chemistry principles applied to chemical engineering process problems; zeta potential and its applications; specific problems involving surface chemistry and physics. Prerequisite: Permission of instructor.

10-509 MATHEMATIC APPLICATIONS IN CHEMICAL ENGINEERING I(3-0)3
Applications of ordinary, partial differential and finite difference equations in the solution of chemical engineering problems. Integral transforms and generating functions are also included. Prerequisite: Permission of instructor.

10-514 PROCESS OPTIMIZATION II(3-0)3
An advanced study of modern optimization techniques having applications in process economics, process analysis, process dynamics, process kinetics and process design; methods such as linear, nonlinear, geometric, dynamic programmings, discrete and continuous maximum principles. Prerequisite: Permission of instructor.

10-517 MASS TRANSFER OPERATIONS II I(3-0)3
Fundamentals and modeling techniques for the separation process of distillation. Flash distillation, batch distillation, multicomponent distillation. Shortcut design method, Lewis-Matheson method, Thiele-Gedds method, Wang-Henke method, other methods. Optimization. Prerequisite: Permission of instructor.

10-520 ADVANCED THERMODYNAMICS I(3-0)3
The central theme of this course is the use of the Second Law of thermodynamics to reduce energy consumption in operations and processes in the chemical industry. Lost work analysis techniques are developed for the evaluation of thermodynamic processes. Areas of study include power cycles, refrigeration and distillation. Prerequisite: Permission of instructor.

10-521 INTRODUCTION TO ENVIRONMENTAL ENGINEERING I(3-0)3
This is an introductory course to the problems of environmental pollution in all its aspects. Air and water pollution are given particular emphasis and special projects are assigned for student investigation. The course is concerned with the assessment and evaluation of the magnitude of the problem, but does not consider in depth the known or possible solutions to environmental pollution problems. Prerequisite: Permission of instructor.

10-524 ADVANCED CHEMICAL PROCESS I(3-0)3
Detailed study of several commercial processes from the standpoint of engineering principles and economics. Economics and interrelationships of the chemical industry. Analysis of specific real problems. Factors involved in determination of best design from several alternatives. Term paper required. Prerequisite: Permission of instructor.

10-526 ADVANCED HEAT TRANSFER II(3-0)3
Review of principles of energy transport. Specific problems in convection and radiant heat transfer. Mathematical treatment of unsteady-state heat transfer. Prerequisite: Permission of instructor.

10-528 ADVANCED TRANSPORT PHENOMENA

II(3-0)3

A systematic, fundamental approach to momentum, heat and mass transfer. Transport equations are developed both on the microscopic and macroscopic viewpoint. Analogies and similarities between the transfer processes are discussed. Considerable emphasis is placed upon solutions to problems. Prerequisite: Permission of instructor.

Paper Engineering (Course Prefix: 11)

11-503, 11-504 ADVANCED CONVERTING PROCESSES

(3-0)3, (3-0)6

Specific converting processes. Analysis of coating processes, water and solvent based, extrusion and hot melts. Latest techniques used by the converting industry, involving mechanical and chemical operations. Engineering analysis of processes. Oral and written reports, plant visits, and laboratory assignments. Prerequisite: Permission of instructor.

11-505 THE PHYSICS OF PAPER

(3-0)3

Structures of fibers from a fundamental viewpoint and their effect on strength and other properties of sheets made of these fibers. Comparison of cellulosic fibers and synthetic fibers. Engineering properties of fibrous materials. Prerequisite: Permission of instructor.

11-506 NEW TECHNIQUES IN THE PAPER INDUSTRY

(3-0)3

Lectures and discussions of new developments in engineering, design, and application of physical and chemical principles in the manufacture of paper products. Economic comparisons of new processes. Oral and written reports, plant visits, and laboratory assignments. Prerequisite: Permission of instructor.

11-507 FUNDAMENTALS OF REPROGRAPHY

(3-0)3

An in-depth study of replicating and imaging systems from carbon paper to xerography, to halography, covering theory and principles of operations, design and development of hardware and supplies, typical specifications and a cursory economic evaluation of these systems. Because of the unique technical character of this new field, a review of copyright, patents and trade secrets is provided. The current state of the art is reviewed and the potential represented by recent developments in the field is examined. Prerequisite: Permission of instructor.

11-508 ADVANCED PAPER SYSTEMS ANALYSIS

(2-3)3

The course has two functions: firstly, to study the programming and operations of single board micro computers used for control applications; Secondly, to review the papermaking operation with intent of introducing the various types of control and measurement systems as found in typical mill operations, including those systems found on the paper machine. Project time is allocated to allow the students time for micro computer programming and the setup of simulated mill control situations. Prerequisite: Permission of instructor.

11-512 ADVANCED FIBER PROCESSING

(3-0)3

A study of fiber properties as related to fiber processing. Treatment of various theories of fiber processing. Discussion of mechanical treatments of fibers on the wet and dry properties of papers made from these fibers. Prerequisite: Permission of instructor.

11-513 NON-CELLULOSICS IN THE PAPER INDUSTRY

(3-0)3

An analysis of the role of non-cellulosics such as glass and polymeric materials in the field of paper technology. Characteristics imparted to paper structures and economics will be evaluated. Prerequisite: Permission of instructor.

11-516 ANALYSIS OF PAPER FORMATION PROCESS

(3-0)3

Discussion of the variables and factors involved in the formation of the paper web. Consideration given to fiber flocculation and orientation and to head-box design. Prerequisite: Permission of instructor.

11-520 ENVIRONMENTAL PROBLEMS IN THE PAPER INDUSTRY

(3-0)3

An in-depth study of the technical and economic aspects of the problems of the paper industry as they relate to environmental impact. Review of current technologies and assessment of future developments required to fulfill governmental requirements of EPA, OSHA and other agencies. Prerequisite: Permission of instructor.

11-651 SELECTED TOPICS IN PAPER ENGINEERING

(3-0)3

Advanced topics in the various fields of paper engineering. Contents may vary from year to year to reflect contemporary applications of paper engineering. Prerequisite: Permission of instructor.

DEPARTMENT OF CIVIL ENGINEERING

Chairperson: Donald Leitch

Professors: Nathan Gartner, William Haskell, William Moeller, Charles Ott, Burton Segall, Herman Shea

Associate Professors: Donald Leitch, John Sewell, Louis Tartaglione.

Assistant Professor: Norman Bolyea, Rezene Medhani.

Civil Engineering is that branch of engineering charged with the planning, design, construction and operation of works vital to man's activities in his relations to the environment.

The concerns of the Civil Engineer include engineering structures or total facilities to accommodate residential, business, industrial, scientific and recreational pursuits; planning, designing and developing avenues of transportation; and the gathering and processing of environmental information. Civil Engineers are called upon to adapt natural or man-made materials to the works under their control. In this role they are involved in the control and management of the forces of nature as they affect the environment, or are dealing with the treatment and disposal of solid, liquid and aerial waste.

Civil Engineering Program

Graduates in Civil Engineering are prepared to apply their training in the widest range of society's projects. They are employed to work in the development of highways, railroads, airports and those areas having to do with water and waterways, such as bridges, dams, canals and levees. Water treatment plants and distribution systems for municipal and industrial water supplies, as well as wastewater treatment plants are in their scope of interests.

The Civil Engineering aspects of high-rise buildings, power plants, industrial, military and space-age facilities require the expertise of trained Engineers. Advanced training can lead to careers in teaching and research.

Because of the broad spectrum of the Civil Engineer's activities, the curriculum of the Department of Civil Engineering is based on a wide range of general scientific and engineering principles. The fundamental base is subsequently expended into specialized subjects to give students a comprehensive, well-grounded training in the functions and responsibilities of the Civil Engineer. The curriculum of the Department is accredited by the Accreditation Board for Engineering and Technology (ABET).

COURSE OF STUDY FOR CIVIL ENGINEERING#

Freshman Year

Fall Semester

00-101 Perspectives in Eng. 1
42-101 College Writ. I. 3
*84-121 Chemistry 3
*84-123 Chem. Lab. 1
92-131 Calculus B-I or
92-133 Calculus A-I 4
+ 95-141 Physics I 3
+ 96-141 Fund. Exp. Phys. I
Physical Ed. 1

16

*84-135 Honors Chem. & 84-137 Honors Chem. Lab.
+ 95-147 Honors Physics & 96-147 Fund. Exp. Physics I
may be substituted.

Sophomore Year

Fall Semester

14-203 Statics 3
14-223 Graphics 1
14-225 Surveying I 3
92-231 Calculus B-III or
92-233 Calculus A-III 3

Spring Semester

42-102 College Writ. II 3
*84-126 Chemistry 3
*84-124 Chem. Lab. 1
92-132 Calculus B-II or
92-134 Calculus A-II 4
+ 95-144 Fund. Phys. I 3
+ 96-144 Fund. Exp. Phys. II
Physical Ed. 1

15

*84-136 Honors Chem. & 84-138 Honors Chem. Lab.
+ 95-148 Honors Physics & 96-148 Fund. Exp. Physics
II
may be substituted.

Spring Semester

14-204 Strengths of Materials 3
14-226 Surveying II 3
42-225 Tech. & Sci. Commun. 3
92-234 Differential Equations 3
92-383 Intro. to Statistics 3

92-261 Intro. to Fortran	2		
Area I or II Elect.	3		
	15 or 16		15
Junior	Year		
Fall Semester		Spring Semester	
14-305 Dynamics	3	14-301 Fluid Mechanics	3
14-310 Engineering Materials	3	14-330 Soil Mechs. I	3
14-350 Structural Analysis	3	14-340 Transportation	4
14-372 Civil Eng. Systems	3	14-352 Reinforced Concrete	3
64-201 Economics	3	14-362 Sanitary Eng. I	3
Area I or II Electives	3		
	18	16	
Senior	Year		
Fall Semester		Spring Semester	
14-431 Found. & Soil Eng.	3	14-461 Water Resources Designs	3
14-462 Steel Design	3	14-470 Civil Eng. Economics	3
14-460 Water Resources Eng.	3	*14-XXX Civil Eng. Elct.	3
*14-XXX Civil Eng. Elct.	3	16-214 Elct. Machinery Lab.	1
16-348 Basic Elct. Eng. Concp.	3	22-347 Elm. of Thermodynamics & Heat Transfer	3
Area I or II Elect.	3	Area I or II Elect.	3
	18		16

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

* ROTC or Civil Elective

The Five-Year BS/MS Program

The purpose of this program is to offer qualified undergraduate students a coherent program of study whereby a Master of Science degree may be realized at the end of 5 years of study. The student benefits from the efficiency of a continuous, coordinated sequence of subjects which allows for reduced credit hour requirements.

General Requirements

A minimum grade point average of 3.0 is required for admission into the 5 year Civil Engineering graduate program. However, a student with an average between 2.70 to 3.0 may be admitted provisionally with departmental approval. The grades of the student's first 5 semesters will be used to determine the grade point average.

Applicants who satisfy the Graduate School and Civil Engineering Department admission requirements for the five year program will be assigned a Graduate Faculty member who will act as their program advisor. The M.S. degree requires the successful completion of a minimum of 30 credit hours. These 30 hours include at least 24 hours in class and seminar study of which at least 18 hours must be at the 500 level or higher. Also, at least 6 credit hours must be completed in preparation of a publishable thesis. Three credit hours for preparation of an engineering project report and an additional 3 hour 500 level course may be substituted for the thesis with the program advisor's approval. Courses at the 400 level are designed for seniors, but under certain circumstances may be taken by graduate students for graduate credit. The student must file a special petition form, obtainable from the Graduate School, at the time of registration for the 400 level courses.

Special Requirements

A student seeking a five year M.S. may undertake a general Civil Engineering program or may choose an area of specialized study. These areas include: Environmental Engineering, Geotechnical Engineering, Structural Engineering, Transportation Engineering and Water Resources. The student who specializes must take at least four electives in the area of specialization or from an associated area as approved by their program advisor.

Required Courses

All students are required to complete the following eight required courses. It is recommended that they take at least 2 of these per term during their 4th and 5th years. The sequencing of the required courses will be determined by the student and his/her advisor in terms of the student's overall plan of study.

Fall Term	
14-431 Foundations and Soils	3
14-452 Steel Design	3
14-460 Water Resources Eng.	3
16-348 Basic EE Concepts	3
	12

Spring Term	
14-470 Civil Eng. Economics	3
22-347 Elementary Thermo & Heat	3
*14-461 Water Resources Designs	3
16-214 Electric Machine Lab.	1
	10

* Course with fall term prerequisite.

Typical Plan of Study

Fall Semester

2 Core Curriculum Courses	6
Area I or II Elective	3
2 Civil Eng. Electives	6
	15 hours

Fifth Year

Fall Semester

2 Core Curriculum Courses	6
2 Civil Eng. Electives	6
Thesis	3
	15 hours

Fourth Year

Spring Semester

2 Core Curriculum Courses	4 or 6
Area I or II Elective	3
2 Civil Eng. Electives	6
	13 or 15 hours

Spring Semester

2 Core Curriculum Courses	4 or 6
2 Civil Eng. Electives	6
Thesis	3
	13 or 15 hours

At least 6 of the required 8 Civil Engineering Electives must be at the 500 level or above. These courses may be taken in Civil Engineering or in an associated area approved by the student's advisor.

The thirty hours that are required for the master's degree are considered to the following:

8 Civil Engineering Electives	24 hours
1 Thesis	6 hours
	30 hours

Under exceptional circumstances, a student wishing to terminate his/her plan of study before the completion of the 5th year must at least successfully complete the 8 core curriculum course requirements, the two Area I or II Electives and the two Civil Engineering electives which are part of this program, to obtain a BSCE.

Civil Engineering (Course Prefix: 14)

14-203 STATICS

I(3-0)3

Vector concepts of forces and moments of forces. Static equilibrium of particles, rigid bodies and simple structures. Static friction forces. Geometric properties of sections. Prerequisites: 92-132 or 92-134, 95-144, 96-144.

14-204 STRENGTH OF MATERIALS

II(3-0)3

The concept of stress and strain at a point. Stress temperature relationships. Force and deformation analyses of bodies under axial, shearing, flexural, torsional and combined loadings. Shear and bending moment diagrams. Prerequisites: 92-231 or 92-233, 14-203.

14-215 ANALYTIC MECHANICS I

I(3,0)3

Statics: vectors, rigid body equilibrium, forces and forcesystems, friction, moment and moment of inertia. Mechanics of deformable body in equilibrium: stress and strain, elastic moduli and mechanical properties of materials. Applications to simple tension, compression, and shear loadings, shafts in torsion, pressure vessels. Prerequisites: 92-132 or 92-134; 95-145; 96-145 or equivalent.

14-216 ANALYTIC MECHANICS II

II(3,0)3

Continuation of 22-215. Elastic deformation of solid bodies under various loading conditions, including beam theory, and buckling theory for loaded columns. Kinetics and Dynamics. Newton's second law including momentum and energy methods. Applications to rigid body motion, central force motion, vibrations, and colliding particles. Prerequisite: 22-215.

14-223 GRAPHICS

I(0-3)1

An introduction to the basic principles of engineering drafting including such topics as engineering lettering, orthographic projections and pictorial representation of solids. Includes the application of graphical methods to typical Civil Engineering projects.

14-225 SURVEYING I

I(2-3)3

A presentation of the basic instruments and equipment commonly used in survey processes such as distance angle and level measurements. A presentation of the principles of closed and open traverses and their relationship to engineering projects such as land surveys and design projects. Subject includes fieldwork practice in the more

elementary operations with a view toward acquiring sound basic skills. Office-type projects in contour drawing and the application of contoured topography to highway and water-control projects. Throughout this subject emphasis is placed on presenting data in forms common to present practice in the Civil Engineering profession.

14-226 SURVEYING II

II(2-3)3

Classroom recitations related to the principles and practice of route surveys and designs. Topics include simple and compound circular curves, intersections of straight and curved baselines, vertical alignment principles including parabolic easement curves, earthwork operations and determination of volumes, and practice of construction surveying. Laboratory work includes office-type projects illustrative of the application of surveying information to Civil Engineering projects such as water resources, sanitary sewers and property subdivision. Detailed fieldwork instruction in basic traverse surveys, gathering of topographic information, and the staking-out of buildings and circular curves.

14-301 FLUID MECHANICS

II(3-0)3

Fluid properties, fluid statics, fluid dynamics including continuity, impulse-momentum and energy equations. Pipe flow, turbomachinery, similitude and modeling. Emphasis will be on incompressible fluids. Prerequisite: Junior status.

14-305 DYNAMICS

I(3-0)3

Vector development of kinematics of a particle with respect to fixed and moving coordinate systems of one, two, and three dimensions. The dynamics of a particle, systems of particles, and rigid bodies. Angular momentum and the inertial properties of rigid bodies. Energy, impulse and momentum. Prerequisites: 92-231, 14-203, 96-144.

14-310 ENGINEERING MATERIALS

I(2-3)3

A treatment of the properties of engineering materials as such influence the design, construction and maintenance of Civil Engineering works. Included are such materials as ferrous and non-ferrous metals, timber, plastics, and cementitious materials. Also includes the description and identification of soils. Supplemented by laboratory testing of various engineering materials. Prerequisites: 84-122, 14-204.

14-330 SOIL MECHANICS

I(3-0)3

Development of the fundamental principles of the science of soil mechanics as utilized in soil and foundation engineering. Includes index properties, classification, strength and deformation properties, and hydraulic properties which are required for foundation and soil engineering design. Prerequisites: 14-204, 14-310.

14-340 TRANSPORTATION ENGINEERING

II(3-3)4

Development of the basic principles pertaining to the movement of people and goods by modern transportation systems. Techno-economic characteristics of the various transportation modes. Aspects of planning, design and operation of land, air and water transportation facilities. Development, structure and function of the U.S. transportation system. Prerequisite: 14-226.

14-350 STRUCTURAL ANALYSIS I

I(2-2)3

Principles of structural analysis applied to typical civil engineering structures as the initial step in the total design concept. Basic emphasis on the analysis of statically determinate structures with elements of modern methods of analysis of indeterminate structures. The digital computer as an analytical tool. Prerequisite: 14-204.

14-352 REINFORCED CONCRETE DESIGN

II(2-2)3

Ultimate strength and elastic behavior of reinforced concrete structural members, continuity in building frames, deflections, shear reinforcement, development length and bar cutoffs, columns and footings. Prerequisites: 14-310, 14-350.

14-362 SANITARY ENGINEERING I

I(3-1)3

Physical, chemical and biological principles of the treatment of water and sewage are considered along with their application to treatment systems. The several system components of water and sewage treatment plants are studied to provide a basis for design capability. Prerequisite: 14-301.

14-372 CIVIL ENGINEERING SYSTEMS

I(3-0)3

Introduction to methods and operations research, management science and economic analysis used in the design, planning and managing of engineering systems. Main topics covered: modeling of engineering systems, application of optimization methods, organizational networks, decision analysis, economic considerations in systems planning. Prerequisite: Junior status.

- 14-431 FOUNDATION AND SOIL ENGINEERING II(3-0)3
The application of soil mechanics to the design and analysis of foundations and soil structures. Includes slope stability analysis and the design of retaining structures, deep and shallow foundations, and the bracing of excavations. Introduction to soil mechanics laboratory practice covering determination of fundamental soil properties. Prerequisite: 14-430.
- 14-433 EXPERIMENTAL SOIL MECHANICS (0-3)1
Introduction to Soil Mechanics Laboratory practice using standard tests for the determination of strength and compressibility characteristics of soil. Also includes the experimental determination, through the medium of term projects, of engineering properties of soil.
- 14-441 TRAFFIC ENGINEERING II(2-3)3
Elements of the traffic system: the user, the vehicle, the roadway. Traffic characteristics; human and vehicular characteristics; volume studies and characteristics. Spot speeds, travel time and delay studies. Roadway and intersection capacities and level of service. Accidents and safety. Parking studies and characteristics. Traffic control devices. Environmental impacts. Prerequisite: 14-340.
- 14-450 STRUCTURAL ANALYSIS II II(3-0)3
Classical and matrix methods of structural analysis applied to complex plane trusses. Elementary space truss analysis. Elementary model analysis through the use of influence lines for indeterminate structures. The digital computer and problem oriented languages as analytical tools. Prerequisite: 14-350.
- 14-452 STEEL DESIGN I(2-2)3
An elementary introduction of structural steel design with emphasis on use and interpretation of the AISC Manual and Specifications. Subjects include design of tension, compression, beams, and beam-column members, plus bolted and welded connections. Other topics may include composite beams, plate girders, building connections and plastic analysis and design.
- 14-456 ADVANCED STRUCTURAL DESIGN I(2-2)3
A study of the design and construction of modern structures for students majoring in structural engineering. Emphasis is placed on special projects, case studies, and the use of the digital computer. Special topics included are torsion of non-circular members, prestressed concrete, beam-columns, design of flat slabs, and elementary earthquake design. Prerequisites: 14-352, 14-452.
- 14-460 WATER RESOURCES ENGINEERING I(3-0)3
Elements of classical hydrogology including groundwater, hydrographs, and statistical analyses of data. Open channel flow and water law. Prerequisite: 14-301.
- 14-461 WATER RESOURCES DESIGNS II(2-2)3
A sequence of brief design projects is presented with projects selected from pumping stations, water transmission systems, distribution networks, sewers, sultverts, drainage systems, waterhammer and surge, hydrologic analysis, water surface profiles and flood routing. Computer methods are used. Prerequisite: 14-460.
- 14-463 SANITARY ENGINEERING II II(3-1)3
A study of the effects of waste discharges on the aquatic environment. Streams, lakes and marine systems are considered. Modeling of effects are explored through use of the Streeter-Phelps equation and various modifications. Stream sampling techniques, data collection and analysis are stressed.
- 14-470 CIVIL ENGINEERING ECONOMICS II(3-0)3
Presentation of mathematical principles of economic analysis, with emphasis on defining alternatives and predicting consequences of proposed investments. Attention is placed on the economic, social and environmental impacts of proposed Civil Engineering projects. The attractiveness of investments are judged by rate of return, equivalent cash flow and benefit cost techniques. Sensitivity analysis and the use of probability in economic studies are also discussed.
- 14-475 CONSTRUCTION MANAGEMENT I(3-0)3
Development of management skills and techniques to plan, schedule, supervise, and control construction projects. Project estimating; labor costs and productivity; construction plans, specifications and contracts, labor relations; time, cost and quality control; construction equipment and project decision making and financing. Prerequisite: Permission of instructor. Bolyea.

14-480	SELECTED TOPICS IN ENVIRONMENTAL ENGINEERING	I,II(3-0)3
14-481	SELECTED TOPICS IN STRUCTURAL ENGINEERING	I,II(3-0)3
14-482	SELECTED TOPICS IN TRANSPORTATION ENGINEERING	I,II(3-0)3
14-483	SELECTED TOPICS IN GEOTECHNICAL ENGINEERING	I,II(3-0)3
Contemporary topics in selected areas of study within civil engineering. Course content will be varied by the instructor to meet the interests of the students.		

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

14-504	ADVANCED STRENGTH OF MATERIALS	I or II(3-0)3
Stress and strain at a point; curved beam theory, insymmetrical bending, shear center, torsion of non-circular sections; theories of failure; introduction to the theory of elasticity, elastic foundations. Prerequisite: Permission of instructor. Leitch.		
14-532	ADVANCED SOIL MECHANICS	I or II(3-0)3
Basic theories of soil mechanics and their application under practical conditions. It will deal with basic strength principles and stress-strain behavior of clay and cohesionless soil. Physical properties of soils will be determined in a laboratory portion of the course. Prerequisite: Permission of instructor. Sewell.		
14-533	ADVANCED FOUNDATION ENGINEERING	I or II(3-0)3
Design and analysis of foundations for various types of soil profiles will be considered. Shallow foundations, including combined footings and rafts, and the use of pile foundations and drilled caissons will be studied. The special problems of foundations contiguous to existing structures and underpinning operations will be investigated. Exploration techniques and field tests and their application to design will be examined briefly. Sewell.		
14-535	ENGINEERING GEOLOGY	I or II(3-0)3
An introduction to the concepts and techniques of engineering geology. Topics will include the geology and morphology of glacial deposits; geological features and their engineering significance; use of borings and geophysical exploration techniques; geologic construction materials; groundwater, water supply, solid and liquid waste disposal; erosion and sedimentation associated with construction activities, reservoir silting and shoreline processes; and the geologic factors considered in earthquake engineering. Case studies and term projects dealing with such activities as land-use planning, reservoir silting, water supply, and dam construction will be included. Certain geologic features and construction projects of New England will be visited during the semester. Prerequisite: Permission of instructor. Sewell.		
14-540	URBAN TRANSPORTATION PLANNING	I(3-0)3
The urban transportation problem. Systems analysis approach to planning. Multimodal urban transportation planning process: goals and objectives; data collection, analysis, and model building; travel demand prediction models: trip generation and distribution, modal choice and network assignment; evaluation of alternative plans. Prerequisite: 14-340 or equivalent. Gartner.		
14-543	TRANSPORTATION SYSTEMS ANALYSIS	Staff (3-0)3
The course presents a framework for the analysis of a wide range of multimodal transportation problems. The basic paradigm: demand, supply and equilibrium. Models of transportation demand and their relation to the socioeconomic system. Modeling transportation technologies and performance functions. The network equilibration process. Prediction of impacts and searching for optimal strategies. Economic, social, environmental and political consequences of transportation decisions. Staff.		
14-550	ADVANCED STRUCTURAL ANALYSIS	I or II(3-0)3
Linear and Non-linear concepts of buckling stability. Beams on elastic foundation. Variable X-section Column Analysis. Introduction to Plates and Shell. Newmark numerical methods of Structural Analysis for deflection mode shapes, and critical buckling. Matrix Structural Analysis review. Prerequisite: Permission of instructor. Tartaglione.		
14-551	DESIGN OF STEEL STRUCTURES	I or II(3-0)3
Elastic and plastic design of structural steel systems, residual stresses; beam-columns; torsion; composite steel-concrete members. Prerequisite: Permission of instructor. Leitch.		

14-552 DESIGN OF REINFORCED CONCRETE STRUCTURES

I or II(3-0)3

Strength method; flexure analysis, shear and torsion; beam-columns; deflections; two-way slabs; flat slabs; creep, shrinkage and temperature effects; prestressed concrete; footings. Prerequisite: Permission of instructor. Leitch.

14-553 TIMBER STRUCTURES

I or II(3-0)3

Design of timber members in tension, compression and bending; design of connections, laminated wood trusses and frames. Prerequisite: Permission of instructor. Leitch.

14-562 GROUNDWATER HYDROLOGY

I or II(3-0)3

Descriptive and analytic treatment of the occurrence, movement and fluctuation of groundwaters will be given. The response of groundwater to wells and the methods of obtaining solutions to well pumping problems will be included. Also to be investigated will be aquifer development and the problem of groundwater and aquifer pollution. The hydrology of landfill leachate will be presented. Prerequisite: Permission of instructor. Moeller.

14-565 INDUSTRIAL WASTE TREATMENT PROCESSES

I or II(3-0)3

An introduction to the unit operations most commonly encountered in industrial waste treatment. Specific industrial applications will be stressed after an understanding of each unit operation has been developed. Prerequisite: Permission of instructor. Ott.

14-567 ENVIRONMENTAL CHEMISTRY I

I(3-0)3

The chemistry of natural and polluted waters and the applied chemistry of water and wastewater treatment. The course provides comprehensive coverage of dilute aqueous solution chemistry of acid-base reactions and complex formation. An introduction to the chemistry underlying the process that occur in natural bodies of water and at treatment facilities. The course emphasizes chemical equilibrium in water, and is intended as a foundation for further environmental studies. Prerequisite: Permission of instructor. Segall.

14-568 ENVIRONMENTAL CHEMISTRY APPLICATIONS

II(3-3)3

The application of natural and polluted water chemistry. Lecture and laboratory projects develop analytical techniques and a knowledge of water treatment technology. Prerequisite: Permission of instructor. Segall.

DEPARTMENT OF ELECTRICAL ENGINEERING

Chairman: F. Ross Holmstrom

Professors: Roger H. Baumann, Peter Burger, F. Ross Holmstrom, E. Russell Laste, James E. Powers

Associate Professors: Francesco L. Bacchialoni, Ronald D. Brunelle, Donn A. Clark, Robert J. Dirkman, Alexander Khazan, J. Robert A. Lemieux, Paul J. Murphy, Robert E. Parkin, Kanti Prasard, Bodo W. Reinisch, Lele G. Shreedar, Anh Tran, David P. Wade, David Wunsch.

Assistant Professors: John Griffiths Barry, George P. Cheney, John P. Leonard, Martin A. Patt, H. James Rome, Stephen J. Spurk.

Electrical Engineering Program

Electrical Engineering is a dynamic field, receiving much of its stimulus from contemporary breakthroughs in the pure sciences. Because engineering disciplines continuously incorporate new concepts and developments, a viable engineering education cannot be limited to the acquisition of specific skills and methods, but also must provide the student with a deep understanding of both the current and the emerging engineering field.

The Electrical Engineering curriculum provides a thorough grounding in electrical science and engineering, together with an intensive training in mathematics, and emphasizes the techniques of experimental science and technology through investigative laboratory work and classroom lecture-demonstrations. Specialization at the undergraduate level is currently limited to the concentration in microwave engineering, but interdisciplinary study is fostered through the selection of technical electives.

An important aspect of the Electrical Engineering curriculum is the technical elective program of the senior year. Technical electives provide opportunities for broadening or deepening technical knowledge in a flexible manner and in accordance with student interests and competencies. Normally, such electives are senior-level Electrical Engineering courses. However, courses in scientific subjects may be taken from the offerings of the College of Engineering or the College of Pure and Applied Sciences up to a maximum of 6 credits when approved by the academic advisor. Approval of such scientific courses is ordinarily granted when their technical content is more advanced than that of required courses in the same areas.

A significant portion of the curriculum is devoted to studies in the humanities and social sciences and considerable choice of subjects is allowed. These subjects broaden the student's outlook and serve to focus attention

on the importance of nontechnical knowledge in determining the student's ultimate level of responsibility in professional life.

Students seeking admission into Electrical Engineering should be familiar with the admission and retention requirements of the College of Engineering. This Curriculum is accredited by the Accreditation Board of Engineering and Technology (ABET).

COURSE OF STUDY FOR ELECTRICAL ENGINEERING#

Freshman Year		Spring Semester	
Fall Semester			
00-101 Perspectives in Eng.	1		
* 84-121 Chemistry	3	* 84-126 Chemistry	3
* 84-123 Chemistry Laboratory	1	* 84-124 Chemistry Laboratory	1
42-101 College Writing	3	42-102 College Writing and Literature	3
92-121 Calculus B-I or		92-132 Calculus A-II or	
92-133 Calculus A-I	4	92-134 Calculus A-II	4
+ 95-145 Physics I	3	+ 95-146 Physics II	3
+ 96-145 Fund. Exp. Phys. I	1	+ 96-146 Fund. Exp. Phys. II	1
Physical Ed.		Physical Ed.	
	16		16
* 84-135 Honors Chem. & 84-137 Honors Chem. Lab.		* 84-136 Honors Chem. & 84-138 Honors Chem. Lab.	
+ 95-147 Honors Physics & 96-147		+ 95-148 Honors Physics & 96-148	
Fund. Exp. Phys. I may be substituted.		Fund. Exp. Phys. II may be substituted	
Sophomore Year		Spring Semester	
Fall Semester			
64-201 Economics I	3	64-202 Economics II	3
16-201 Intro. Ckt. Theory	4	16-202 Intro. Ckt. Theory II	4
16-207 Basic Elec. Eng. Lab. I	2	16-208 Basic Elec. Eng. Lab. II	2
16-227 Intro. Computer Prog.	1	16-228 Prog. & App. Dig. Comp.	3
92-231 Calculus B-III or		92-234 Differential Equations	3
92-233 Calculus A-III	3		
95-235 Modern Physics	3		
	16 or 17		15
Junior Year		Spring Semester	
Fall Semester			
16-311 Elect. Lab. I	2	16-312 Elect. Lab. II	2
16-355 Intro. Electromech.	3	+ 16-360 Electromag. Theory	3
16-362 Signal & Syst. Anal.	3	16-362 Signal & Syst. Anal. or	3
16-365 Electronics I	3	16-355 Intro. Electromech.	3
16-315 Complex Variables Eng.	3	16-366 Electronics II	3
* Area I or II Elect.	3	22-214 Intro. Mechanics	4
*+ Area I or II Elect.	3	*+ Area I or II Elect.	3
	17		18
Senior Year		Spring Semester	
Fall Semester			
16-413 Linear Feedback Syst. or		16-413 Linear Feedback Syst. or	
Tech. Elect.	3	Tech. Elect.	3
16-461 Electromag. Th II.	3	Tech Elective	3
22-347 Elm. of Thermodyn. & Heat Transfer	3	Tech Elective	3
ROTC or Undesign. Elec.	3	ROTC or Undesign. Elect.	3
Area I or II Elect.	3	Area I or II Elect.	3
	15		15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*May substitute one E.E. Technical Elective for any of the five Area Electives Listed.

+ Students enrolled in the Microwave Eng. Concentration will take 16-360 fall semester, junior and 16-461 spring semester, and 16-461 spring semester, junior year.

Combined Five Year B.S./M.S. Program

Regularly enrolled undergraduate students who have achieved above average academic standing through their sophomore year are encouraged to consider the combined B.S./M.S. program which is expected to lead to both degrees by the end of the student's fifth year at the University. In order for this program to be meaningful, the student must make his commitment to the program not later than the beginning of his junior year.

The main benefit of the program is that both the student and the advisor identify the student's academic objectives early in his/her work at the University so that a very efficient and well structured program can be devised which

will minimize the chances of losing courses when offered due to a lack of prerequisites. Because of scheduling and prerequisite problems, very few if any of our regular Graduate students complete the Master's degree program in one year. The five year program circumvents many of these difficulties.

A suggested program of courses and their sequencing is shown below. The following assumptions are made with respect to students admitted to this program.

The student must be committed to the program by the beginning of the Fall term of the junior year.

The students withdrawal from the five year program after the completion of the fourth year, will not effect eligibility for the B.S. degree, provided all work has been satisfactorily completed up to that point in the five year program.

Although the option of registering for summer school at the University exists, it will not be required by the program. In fact, with prior approval, students will be allowed to take up to 6 credit-hours of course work at other accredited institutions and receive transfer credit for all graduate courses carrying a grade of B or better. The usual transfer credit petition must be filed and approved after grades have been received.

A student wishing to pursue the non-thesis option should take one graduate course during the summer between the fourth and fifth year and substitute the Seminar (16.601) and one more graduate level course in lieu of the 6 credit hours of Thesis in the fifth year.

The following program of study is suggested for students admitted to the combined B.S./M.S. programs in Electrical Engineering.

Junior Year		Spring Semester	
Fall Semester			
16-311 Electronics Lab.	2	16-312 Electronics Lab. II	2
16-362 Signals and Systems Anal.	3	16-355 Intro. Electronmechanics	3
16-365 Electronics	3	16-366 Electronics II	3
92-315 Complex Variables for Engrs.	3	13-360 Electronmagnetic Theory I	3
HS#1A Humanistic-Social Elective	3	22-214 Intro. Mechanics	4
* 16-411 Logical Design of Digital Systems I	3	* 16-417 Absolute & Symbolic Programming	3
	17		18

*MSEE and MSST may use other 400 level courses if desired or take standard program.

Senior Year		Spring Semester	
Fall Semester			
HS #2 Humanistic-Social Elective	3	HS #3 Humanistic-Social Elective	3
16-461 Electromagnetic Theory II	3	HS #4 Humanistic-Social Elective	3
22-347 Elements of Thermodynamics and Heat Transfer 3		16-413 Linear Feedback Systems	3
G.C. #1 Graduate Course #1	3	G.C. #3 Graduate Course #3	3
G.C. #2 Graduate Course #2	3	G.C. #4 Graduate Course #4	3
	15		15

Summer Preceding Graduate Year

The student will be expected to develop and write a PROPOSAL for his/her thesis and have it ready for the start of the fall term. (No formal registration involved.)

Graduate Year	
Fall Semester	
G.C. #5 Graduate Course #5	3
G.C. #6 Graduate Course #6	3
XX-701 Thesis	3
T.Elec. Technical Elective #2	3
Und. El. Undesignated Elective 1	12
Spring Semester	
G.C. #7 Graduate Course #7	3
G.C. #8 Graduate Course #8	3
XX-701 Thesis	3
T.Elec. Technical Elective #3	3
Und.El. Undesignated Elective #2	12

It should be noted that the selection of 16-411 and 16-417 in the junior year is primarily for students working toward a Master of Science in Computer Engineering (M.S.C.P.) which is considered to be the "worst case" for purposes of scheduling and prerequisite satisfaction. In the case of MSEE or MSST the student may elect to take these courses or take a standard junior year, depending upon the phasing of our graduate course offerings.

Electrical Engineering (Course Prefix: 16)

16-201 INTRODUCTORY CIRCUIT THEORY I

I(4-0)4

Terminal characteristics of ideal elements, active and passive. Ohm's Law and Kirchhoffs Laws. Introduction to

network topology, independent variables, loop and nodal analysis. Definition and consequences of linearity, superposition theorem. Concept of excitation and response. Passive equivalent circuits; active equivalent circuits, Thevenin's and Norton's theorems. Ideal inductance and capacitance, volt-ampere characteristics, energy relations, graphical differentiation and integration. First-order transients; initial conditions, natural response and natural frequencies. Network response to unit step function and unit impulse. Second-order transients: RLC circuits, natural frequencies and the complex-frequency s-plane. Prerequisite: 92-132 or 92-134 and 95-146.

16-202 INTRODUCTORY CIRCUIT THEORY II

II(4-0)4

Sinusoidal forcing function, complex numbers, phasors sinusoidal steady-state. Average real power, reactive power and rms values. Exponential forcing function, poles and zeros in the s-plane, concept of the system function and its use in determining the forced response and natural behavior of circuits. Frequency response and resonance, reactance cancellation and concept of s-plane vectors. Thevenin's and Norton's theorems, superposition, reciprocity, and maximum power in the frequency domain. Magnetic coupling, mutual inductance, ideal transformer. Impedance and admittance and hybrid parameters for a two-port network. Introduction to matrices and their use in circuit analysis. General response by pre-box techniques. Prerequisite: 16-201 - Introductory Circuit Theory I.

16-207 BASIC ELECTRICAL ENGINEERING LABORATORY

I(1-3)2

Experimental work designed to verify theory and to acquaint students with electrical measurement techniques: experiments on dc meters, bridges, and oscilloscopes. Remainder of experiments are correlated with course 16-201 and concern: resistive measurements, Kirchhoff's Laws, network theorems, conservation of power and maximum power transfer, inductance and capacitance, and first and second-order transients. Corequisite: 16-201.

16-208 BASIC ELECTRICAL ENGINEERING LABORATORY II

II(1-3)2

Experimental work, designed to emphasize electrical measurement techniques of linear-systems with time-varying signals. Wave-form measurements with dc and ac meters as well as advanced use of the oscilloscope with experiments integrated with course 16-202. Experiments concern: Kirchhoff's Laws for phasors, magnitude and phase measurements of impedance, network theorems, frequency response, resonance, inductance and transformers, and maximum power transfer. Prerequisite: 16-207 and Corequisite: 16-202.

16-211 FUNDAMENTALS OF ELECTRICITY

I(3-0)3

An introduction to the basic principles of electricity, including the concepts of voltage, current resistance, inductance, capacitance, energy, and power; Ohm's and Kirchhoff's Laws; Thevenin's and Norton's Theorem's: RC and RL transient analysis; the concept of average and root mean square values; and the analysis of steady state alternating current circuits including complex impedance and phasor notation. Prerequisite: 92-132 or 92-134. Corequisite: 95-146. Not open to students majoring in electrical engineering.

16-212 INTRODUCTORY ELECTRONICS AND MACHINERY

II(3-0)3

The characteristics of two and three terminal devices such as the diode and transistor; diode circuits; load line analysis of amplifiers; transistor amplifier circuits; operational amplifiers and applications, digital logic devices and applications, instrumentations; transformers and ac and dc rotating machines. Prerequisite: 16-211. Not open to students majoring in electrical engineering.

16-214 ELECTRICAL MACHINERY LABORATORY

II(0-3)1

A laboratory course devoted to basic measurement techniques of power consuming and generating equipment. The terminal characteristics of alternating and direct current rotating machines are studied. Transforms and solid-state power control circuitry are investigated. Corequisite: 16-211 or 16-348.

16-227 INTRODUCTORY COMPUTER PROGRAMMING

I(1-2)1

Elementary computer organization and information flow concepts are developed. The theme of problem interpretation and analysis is stressed through program flow charting, coding, and documentation. The FORTRAN IV programming language is used to solve problems involving numerical integration, series solutions, list sorting, array manipulation and elementary matrix operations. The interpretation of computer results and verification of program correctness are emphasized. Prerequisite: 92-131 or 92-133.

16-228 PROGRAMMING AND APPLICATION OF DIGITAL COMPUTERS

II(2-3)3

An introduction to programming techniques required in the development of large programs with emphasis on user-developed main programs that link disk-stored subprograms. Topics include definite and indefinite numerical integration, piecewise-linear function generation, first order linear and nonlinear differential equa-

tions, simultaneous equations with real variables, determination of the magnitude and phase of rational functions, time domain and frequency domain plots. Prerequisite: 16-227.

16-261 DIGITAL SYSTEM DESIGN I

I(3-0)3

Design of combinatorial binary networks taught from the engineering point of view. Specification of simple binary gates, such as AND, OR, NAND, NOR, and their interconnection in logic diagrams. Boolean algebra. Algebraic, graphical, and logic circuit minimization techniques. The Karnaugh map. The design and functional characteristics of more complex digital circuits, such as multiplexers, adders, encoders, decoders, demultiplexers, and comparators. Practical MSI and LSI integrated circuits, such as ROMs, PLAs and ALUs. Application of integrated circuits to the design of subsystems in digital computers. Corequisite: 16-263.

16-262 DIGITAL SYSTEM DESIGN II

II(3-0)3

Design of general synchronous sequential systems and digital computers taught from the engineering point of view. Classes of flip-flops, and methods of their triggering. Master-Slave and Edge-triggered circuits. Analysis and design of clocked sequential circuits. State tables, state equations and state diagrams. Design with J-K and D-type flip-flops. State assignments and state reduction. More complex sequential circuits, such as registers, counters and shift registers. Serial addition, and serial processing. The memory subsystem. Register-transfer logic and digital computer design. Use of practical MSI and LSI and integrated circuits for the design of a model digital computer incorporating general registers, common addressing modes and conditional instructions. Prerequisites: 16-261, 16-263. Corequisite: 16-264.

16-263 DIGITAL DESIGN LABORATORY I

I(1-3)2

A laboratory course with experiments coordinated with the subject matter of 16-261. The students wire their experiments using portable digital design kits that are based on modern digital integrated circuit packages as building blocks. The experiments range from simple NAND circuits to the design of a complex arithmetic logic unit (ALU). Effective methods for testing complex digital circuits are emphasized. Producing well organized technical reports on the experiments is also an important requirement of this course. Corequisite: 16-261.

16-264 DIGITAL DESIGN LABORATORY II

II(1-3)2

Continuation of the 16-263 laboratory course with experiments coordinated with the subject matter of 16-262. Use of the oscilloscope for testing clocked sequential circuits. The same kits are used as in course 16-263 with the addition of integrated circuit packages which perform sequential circuit functions. The experiments range from the design of one flip-flop to the design of a complex model of a digital computer CPU. Both effective testing techniques and good technical reports are emphasized also in this course. Prerequisite: 16-261, 16-263. Corequisite: 16-262.

16-290 INTRODUCTION TO INDUSTRIAL ELECTRICITY

(3-0)3

An introduction to elementary circuit analysis. The course content includes the study of transformers, rotating machines, vacuum tubes, transistors, integrated circuits, analog and digital devices. For industrial technology students only.

16-291 INDUSTRIAL ELECTRICITY LABORATORY

(0-3)1

A laboratory experience verifying the concepts of 16-290 and an exposure to the measurement of various electrical and mechanical parameters. For engineering technology students only. Corequisite: 16-290.

16-311 ELECTRONICS LABORATORY

II(1-3)2

A laboratory course with experiments coordinated with the subject matter of 16-365. Characteristics and use of dual-trace oscilloscopes employing a variety of plug-in amplifiers, and other related electronic equipment. Methods of characterizing diodes and transistors. Analysis of performance characteristics of digital and linear semi-conductor circuits, including logic elements and amplifiers at low frequencies. Prerequisite: 16-208. Corequisite: 16-365.

16-312 ELECTRONICS LABORATORY II

II(1-3) 2

A laboratory course with experiments coordinated with the subject matter of 16-366. High-frequency characteristics of transistors and transistor amplifiers. Feedback in electronic circuits. Electronic oscillators. Differential amplifiers. Properties of linear IC operational amplifiers, and their application in amplifier circuits and waveform generation circuits. Digital and linear circuit design and analysis. Prerequisite: 16-311. Corequisite: 16-366.

16-315 COMPLEX VARIABLES FOR ENGINEERS**I(3-0)3**

Complex variables with emphasis on electrical engineering applications. Analytic functions, Cauchy-Riemann conditions. Line integrals, Cauchy's integral formula and residues. Singularities. Taylor and Laurent series. Inversion of Laplace Transforms with residues, principle of the argument, stability and Nyquist criterion. Prerequisite: 92-231 or 92-233.

16-348 BASIC ELECTRICAL ENGINEERING CONCEPTS**II(3-0)3**

An introduction to the basic principles of electricity, including the concept of voltage, current, resistance, inductance, and capacitance; Ohm's and Kirchhoff's Laws; Thevenin's and Norton's Theorems. Other areas of coverage will include sinusoidal steady state analysis of RLC circuits, motor and generator concepts and an introduction to solid state devices including the semiconductor diode and transistor. Prerequisite: 92-132 or 92-134.

16-350 INDUSTRIAL ELECTRICAL POWER**II(3-0)3**

An introduction to direct current and alternating current analysis of circuits. Energy and power. Electromagnetism, transformers, rotating machines, and industrial measuring instruments. Single phase and polyphase systems are used in industrial plants. Efficiency and economic usage are emphasized. Electronic instrumentation as used in measurements and control. Prerequisite: 92-231 or 233.

16-355 INTRODUCTORY ELECTROMECHANICS**I(3-0)3**

Introduction to magnetic circuits, dc motors and generators, singly and multiply excited systems. Three phase circuits, three phase synchronous generators and motors. Transformer equivalent circuit, the autotransformer, three phase connections. Three phase induction motor, single phase motors. Corequisite: 16-202.

16-360 ELECTROMAGNETIC THEORY I**I, II(3-0)3**

An intermediate course in electrostatics and magnetostatics using vector calculus. Topics include: the electric field, line and surface integrals, potential, the divergence theorem. Gauss Law, capacitance, conductors, dielectrics. Poisson's and Laplace's equations, the Biot-Savart law, Stokes' theorem, scalar and vector and magnetic potentials, force and torque on conductors, magnetic circuits and inductance. Prerequisite: 92-232 or 92-234.

16-362 SIGNAL AND SYSTEM ANALYSIS**I, II(3-0)3**

Natural and forced response of linear systems; exponential excitation, system function and impulse response using singularity balancing. Time-domain analysis of systems convolution in the time domain, orthogonal signals. Fourier series representation. Frequency-domain analysis of systems; properties of Fourier and Laplace transforms and their application to the analysis of filters and electric circuits. Prerequisite: 16-202 and 92-232 or 92-234.

16-365 ELECTRONICS I**I(3-0)3**

A brief introduction to solid-state physics, leading to discussion of physical characteristics of pn junction diodes and transistors. Circuit models for diodes, and diode applications. Circuit models for transistors, and transistor applications in digital circuits and low-frequency amplifier circuits. Analysis of digital circuits and linear circuits based on application of circuit models of devices and circuit theory. Prerequisite: 95-235, 16-202.

16-366 ELECTRONICS II**II(3-0)3**

A continuation of 16-365 with discussion of multi-transistor circuits at high frequencies. Feedback amplifiers and oscillators. Differential amplifiers and operational amplifiers. Circuit design employing linear IC operational amplifiers. Examples of electronics applications in the areas of high-frequency circuits, power amplifiers, and hybrid analog/digital systems. Prerequisite: 16-365.

16-371 MICROPROCESSOR APPLICATIONS LAB**I(2-3)3**

Laboratory course with accompanying lecture involving microprocessor programming and interfacing techniques. Topics include hexadecimal numbers, microprocessor instruction sets, arithmetic and logic operations, branching, arrays and stacks, subroutines, interrupts, address decoding, interfacing memory, data output and input, use of the peripheral interface adapter, digital-to-analog and analog-to-digital conversion. Prerequisite: 16-264. Corequisite: 16-373.

16-403 MICROWAVE DESIGN THEORY**I(3-0)3**

An introductory course in the analysis and design of passive microwave devices beginning with a review of time-varying electromagnetic field concepts and transmission lines. Impedance matching techniques, terminations, attenuators, phase changers, directional couplers, hybrids. Microwave devices employing Faraday rotation, elec-

tromagnetic resonators. Survey of semiconductor devices suitable for microwave frequencies. Prerequisite: 16-461.

16-408 through 16-410 PROJECT LABORATORY

I(0-4)3

The purpose of this course is to provide an opportunity to qualified electrical engineering students to investigate specific areas of interest. The actual project undertaken may be software or hardware oriented or be library research or some combination. The most important characteristic of the projects are that the end results represent an effort in independent study, that they are research and development oriented, and that they are accomplished with a practical attitude in an engineering environment. Design reviews, progress reports, and a final formal report is expected for each project. Prerequisite: Permission of instructor.

16-411 LOGIC DESIGN AND DIGITAL SYSTEMS I

I(3-0)3

A review of number systems and base conversion. An introduction to Boolean algebraic and combinatorial logic concepts. Minimization techniques including Boolean algebraic manipulation, the Karnaugh map method, and the Quine-McCluskey tabular method. Simplification techniques are also applied to multiple output networks and incompletely specified functions. Error detection and correction codes. Code conversion, read-only memory (ROM), multiplexers, and programmed logic arrays (PLA). An introduction to sequential machines including state table, state diagram, and minimization concepts. Prerequisite: 16-228.

16-412 LOGIC DESIGN OF DIGITAL SYSTEMS II

II(3-0)3

The general characteristics of finite synchronous and asynchronous sequential machines. State diagrams, state tables, implication tables and graphs are used to determine equivalent states and therefore, equivalent minimal sequential machines. State assignment and complete machine logic design. Hazards in combinational and sequential networks. Introduction to neural networks. Turing machines, and automata. Prerequisite: 16-411.

16-413 LINEAR FEEDBACK SYSTEMS

II(3-0)3

Concept of feedback; open loop and closed loop systems. Feedback in electrical and mechanical systems. Mathematical models of systems and linear approximations. Transfer functions of linear systems, block diagrams and signal flow graphs. Sensitivity, control of transient response, disturbance signals. Time domain performance: steady state errors, performance indices. Stability related to s-plane location of the roots of the characteristic equation. Routh-Hurwitz criterion. Graphical analysis techniques: root locus, frequency response as polar plot and Bode diagrams. Closed loop frequency response and Nichols chart. Prerequisite: 16-362.

16-414 FEEDBACK CONTROL SYSTEMS

I(3-0)3

Time domain analysis of control systems. Analysis of higher order control systems. Compensation by root locus, frequency domain, and algebraic techniques: Truxal's and Chen's method for compensation. A.C. carrier and digital control systems. Prerequisite: 16-413.

16-416 ELECTRONIC AMPLIFIER CIRCUITS

II(3-0)3

An integrated treatment of the analysis and design of electronic amplifiers. Typical amplifier specifications such as noise figure, intermodulation, intercept point, power dissipation, frequency response, gain compression point, and VSWR are discussed in detail. Emphasis is then placed on the choosing of electronic devices and circuit configuration based on amplifier and system design objectives. Prerequisite: 16-366.

16-417 MACHINE AND ASSEMBLY LANGUAGE PROGRAMMING

I, II(3-0)3

An introduction to machine and assembly language programming and coding fundamentals. Typical digital computer organization; breakdown of function blocks including arithmetic unit, control unit, memory and input-output structure. Computer word formats: single and double precision, floating point and instruction words. Machine instructions and methods of execution. Symbolic coding. Address modification, index registers and looping. Subroutines, calling sequences and utility routines. Input-output programming. Table processing techniques. Programs will be run by students on DEC PDP-II minicomputers in the Electrical Engineering Department.

16-420 COMPUTERS IN ENGINEERING ANALYSIS & DESIGN

II(3-0)3

An advanced programming course which considers the digital computer as a tool for solving significant engineering problems. The course is based on a specific area in engineering which will be selected from such topics as large scale circuit analysis, systems simulation, optimization techniques, etc. Typical algorithms related to the specific topic will be studied. User oriented programs or subroutine packages will be developed as a class project. Prerequisite: 16-228.

16-425 WAVE SHAPING AND GENERATION I**I(3-0)3**

Principles and methods of wave shaping and wave generation using active and passive elements. Steady-state switching characteristics of electronic devices. Clipping, clamping, and switching circuits. DTL, TTL, ECL, PL, CMOS, NMOS. Noise margins. Logic circuits. Comparing speed, power, fanout, noise margins. Registers, flip-flops, counters, memories. Monostable, astable multivibrators. Timers. Prerequisite: 16-366.

16-426 WAVE SHAPING AND GENERATION II**II(3-0)3**

Bistable, monostable, astable multivibrators, comparators and sweep circuits. Negative resistance devices and switching circuits. Sampling gates, counting and timing, synchronization, frequency division. Prerequisite: 16-425.

16-429 NETWORK SYNTHESIS**I(3-0)3**

Review of linear system analysis methods: consideration of natural frequencies for impedance-by-inspection techniques. Tellegen's theorem: general reciprocity relation and driving point impedance characteristics. Positive-real functions: definitions and tests. Hurwitz polynomials and Sturm tests. Properties of LCT, RCT, RLT, and RLCP one-ports with Cauer, Foster, and Brune network realizations. Partial-pole removals and introduction to transfer function realizations. Prerequisites: 16-362, 16-315.

16-434 ACTIVE NETWORK THEORY**I(3-0)3**

A study of active inductorless networks with emphasis on design and implementation. The course will cover the following subjects: Approximation Theory, the Operational Amplifier, the gyrator, the negative impedance converter, analysis of basic second order active building blocks, the biquad building block, the state variable filter, and the design of filters. The course will include a design project. Prerequisite: 16-366.

16-436 INTRODUCTION TO MICROPROCESSORS**I, II(2-3)3**

A hardware-oriented course designed to acquaint students with the principles of simple microprocessor architecture as it is manifested in some of the more popular devices and chip families. The course will consider processor concepts, CPU hardware, and support chips and the software instruction sets. Focus will be on the 8080-8085 devices. There will be hands on experience with microprocessor software development systems. Enrollments limited. Prerequisites: 16-411, 16-417.

16-439 COMMUNICATION THEORY AND SYSTEMS I**I(3-0)3**

An introduction to the study of the time-domain and frequency domain characteristics of signals arising in communication systems. Fourier analysis, correlation functions, power and energy density spectra. The time and frequency characteristics of thermal noise voltages. A brief introduction to probability theory as applied to random signals and noise. Signal-to-noise ratio, and noise figure. Prerequisite: 16-362.

16-440 COMMUNICATION THEORY AND SYSTEMS II**II(3-0)3**

Analysis of the operating characteristics and performance of communication systems, including radar. Spectral characteristics of AM, FM, AND PCM signals. Signal characteristics of modulators, amplifiers, mixers, and demodulators. Noise performance of transmission-line and antenna-to-antenna communication links. Prerequisites: 16-362, 16-439.

16-443 ELECTRICAL POWER SYSTEMS I**I(3-0)3**

An intermediate course in analysis and operation of electrical power systems using mathematical techniques including applied calculus and matrix algebra. Considerations will be given to topics such as network reductions and representation of lines, generators, and transformers, network topology and transform methods. Emphasis is placed upon the bus impedance matrix and its corresponding rake equivalent circuit for use in power network problems. Symmetrical components will be introduced with application to polyphase systems. Prerequisites: 16-202, 16-355.

16-444 ELECTRICAL POWER SYSTEMS II**II(3-0)3**

A continuing use of symmetrical components and the rake equivalent circuit as further applied to the analysis of polyphase systems. Particular emphasis will be given to fault studies in three-phase systems. An introductory study, using selected numerical methods will be directed to load flow, economic dispatch, unit commitment, and system stability. Prerequisite: 16-443.

16-445 ANALOG DEVICES AND TECHNIQUES**I(3-0)3**

An survey of analog devices and techniques, concentrating on operational amplifier design and applications. Operational amplifier design is studied in order to reveal the limitations of real operational amplifiers and to

develop an understanding of specifications. Representative applications are covered, including: amplifiers, differential and instrumentation amplifiers, summers, integrators, analog computation, nonlinear circuits, signal processing circuits and waveform generation circuits. Prerequisite: 16-366.

16-451 MODERN OPTICS

I(3-0)3

Maxwell's equations in vacuum, as well as in nonlinear, nonisotropic media. Reflection and refraction, interference and diffraction, Helmholtz equation, polarization, Brewster's angle and modes (TE, TM, TEM). Basic theory of various laser types; coherence and partial coherence. Introduction to quantum mechanics. The role of noise in optical systems. Examples of optics engineering; fiber optics and optical logic gates, optical tracking, optical detection, masers, holography and medical electronics applications. Prerequisites: 16-362 and 16-461.

16-461 ELECTROMAGNETIC THEORY II

I, II(3-0)3

Extension of 16-360 to time varying fields. Topics include: Faraday's law, displacement current, Maxwell's equations, plane waves, Polynting's theorem, skin depth, transmission line theory, Smith chart. Prerequisite: 16-360.

16-462 ANTENNAS

II(3-0)3

An introduction to the properties of individual antennas and arrays of antennas. Retarded potentials, dipoles of arbitrary length, radiation pattern, gain, directivity, radiation resistance. The loop antenna. Effects of the earth and ionosphere. Reciprocity, receiving antennas, effective length and area. Arrays: colinear, broadside, endfire. Array synthesis. Mutual coupling. T.V. antennas, log periodic and Yagi arrays. Radiation from apertures, the waveguide horn antenna. Noise temperature. Prerequisite: 16-461.

16-464 INTRODUCTION TO MICROPROCESSORS

I or II(3-0)3

A software-oriented course designed to acquaint students with the principles of microprocessor systems architecture. The course will look at concepts, hardware and chips, and the software needed to implement some real systems, and it will focus on the Intel 8080-8085 family for programming and detailed hardware design. A three-terminal MUPRO Development System will be used for hands-on practice. Prerequisite: 16-417.

16-465 DIRECT ENERGY CONVERSION

I(3-0)3

Review of first and second law of thermodynamics; thermoelectric, photoelectric, and thermionic conversion. Fuel cells, magnetohydrodynamic and electrogasdynamic conversion. Fusion. Nuclear fission, reactor theory, reactor control and operation. Prerequisite: 16-355.

16-470 DIGITAL SIGNAL PROCESSING

I or II(3-0)3

This course covers the analytical material necessary to prepare actual computer implementation of the desired signal processing. Topics considered are: Definition of discrete signals and systems. Difference equations. Z-transform. Discrete Fourier series and transform. Circular convolution. Signal flow-graph structures for digital filters. Quantization effects. Design of digital filters. Computation of the discrete Fourier transform. Prerequisite: 16-362.

16-484 PROBABILITY IN ELECTRICAL ENGINEERING

I or II(3-0)3

Introduction to elementary probability theory: combinatorial analysis, conditional probability, axiomatic definition of probability. Random variables, probability densities and distributions, expectation, moments, operations with several random variables. Application of Bayes statistics to engineering problems, conditional probabilities and reliability considerations. Random processes, applied to such processes as Poisson, and shot noise. Correlation function and spectral analysis of linear systems applied to S/N and elementary detection and decision problems. Prerequisite: 16-362.

Primarily for Graduate Students

16-500 PRINCIPLES OF ELECTRICAL ENGINEERING

Staff (3-0)3

Fundamental definitions and circuit laws with applications. Important network theorems such as superposition and Thevenin's theorem. First order transients and forced responses. Diode transistor, and FET large-signal models. Pulse and digital circuits including transistor and FET switches, waveshaping schemes, multivibrators and logic gates. Switching-speed, propagation times, fan-in and fan-out characteristics of DTL and TTL logic-families.

Although this course is primarily intended for students whose undergraduate major was in an engineering or scientific discipline other than electrical engineering, it is also recommended for students who have received their

Bachelor of Science in Electrical Engineering degree more than five years ago and who feel the need for a review of electrical principles. In any case, graduate credit will be given on to MSCP and MSST degree candidates not holding a BSEE, while those with the B.S.E.E. degree must substitute a three (3) credit hour elective to satisfy the requirements for the MSCP degree. Prerequisite: BS In Engineering or Science.

16-503 SOLID-STATE PHYSICAL ELECTRONICS I

Staff (3-0)3

Introduction to the behavior of solid-state electronic devices from the viewpoint of modern physics; review of classical mechanics and Maxwell's equations. The Bohr atom, wave-particle duality, wave packets, Schrodinger's equation, band theory of solids; electrons and holes. Mechanical and acoustical properties of solids, semiconductor behavior. Prerequisite: 16-360.

16-504 SOLID-STATE PHYSICAL ELECTRONICS II

Staff (3-0)3

Continuation of 16-503. Semiconductor devices: Schottky diodes, p-n junction devices, junction transistors, field-effect transistors, photo-diodes, varactors. Electro-optic devices, electroluminescent diodes and laser diodes. Magnetism and magnetic devices. Prerequisite: 16-503.

16-505 MICROWAVE ELECTRONICS

Staff (3-0)3

Design oriented course dealing with Solid State Active Microwave Devices. Amplifiers, Oscillators, Switches, Modulators, Mixers, Limiters. Realization of Microwave Systems through MIC (Microwave Integrated Circuit) Techniques. Computer Analysis Aids for Microwave Designs. Prerequisite: 16-461.

16-507 ELECTROMAGNETICS I

Staff (3-0)3

Maxwell's Equations, Poynting's Theorem, Boundary Value Problems in Electrostatics and Electrodynamics, Green's Functions, Retarded Potentials, Reflection and Refraction of Plane Waves, skin effect, Wave Guides. Prerequisite: 16-461.

16-508 ELECTROMAGNETICS II

Staff (0-9)3

Wave propagation in plasma and ferrites, space charge waves, microwave circuits, elementary antenna theory, the dipole, loop, and simple arrays, Huygen's principle and radiation from apertures. Prerequisite: 16-461.

16-509 LINEAR SYSTEMS ANALYSIS

Staff (3-0)3

Classical solution of linear systems described by differential equations. Duals, analogs, and electromechanical systems. System function, step and impulse response, and initial conditions. Time-domain convolution. Fourier analysis, series, and integral: impulse method for obtaining transforms. LaPlace transforms: evaluation and properties. Complex variable theory; complex differentiation and Cauchy-Riemann equations. Complex integration: Cauchy's theorem and Cauchy's integral formulas. Taylor and Laurent series and the residue theorem inverse LaPlace transforms. Introduction to Z-transforms. Prerequisite: 16-362.

16-513 LINEAR CONTROL THEORY & ANALYSIS

Staff (3-0)3

Transient performance of linear feedback control systems for deterministic inputs, using state variable formulation. Block diagram representation and analysis of typical systems. Development and application of Routh-Hurwitz, Nyquist, and root-locus. Stability. Comparison of several compensation configurations for both static and dynamic performance criteria, including the effects of specific disturbances. Consideration of controllability and observability. Prerequisite: 16-362.

16-515 NONLINEAR CONTROL SYSTEMS

Staff (3-0)3

Analytic and numerical methods for the analysis and desing of non-linear control systems. Phase plane, describing function, the methods of Lyapunov and Popov and other non-linear analysis techniques are treated. Pre-requisite: 16-413 or 16-513.

16-517 OPTIMAL CONTROL SYSTEMS

Staff (3-0)3

A study of the analysis and design of optimal control systems by dynamic programming, calculus of variations, and Pontryagin's Method. Prerequisite: 16-413 or 16-513.

16-519 DIGITAL CONTROL SYSTEMS

Staff (3-0)3

The sampling process, reconstruction of sampled signals, z-transforms, signal-flow graph representation of digital systems. The state variable approach to discrete data systems, time solutions by state variable methods. Stability of discrete data systems. Introduction to optimal control of discrete data systems. Prerequisite: 16-413 or 16-513.

16-520 REAL-TIME COMPUTING

Staff (3-0)3

Numerical algorithms fundamental to scientific computation. Elementary discussion of error, polynomial interpolation, numerical integration, solution of non-linear equations, function minimization by the method of steepest descent, numerical solution of systems of ordinary differential and difference equations with applications in the study of continuous and discrete-time dynamical studies. Prerequisite: 16-228.

16-521 AUTOMATA STUDIES

Staff (3-0)3

Mathematical foundation of automata, including probabilistic logics, neuron analog, Tuning machines, and learning theory. Prerequisite: 16-412.

16-522 DATA STRUCTURES

Staff (3-0)3

Character strings, character and character substring searches; lists, their storage structures and uses; trees, tree searches, and storage concepts; compiling, Polish strings, translating from infix to postfix and prefix, conversion to machine code. Prerequisite: 16-328 and/or Permission of instructor.

16-523 COMPLIER STRUCTURES

Staff (3-0)3

Translators and interpreters for programming languages. Syntax of programming languages, syntax directed compilation. Parsing techniques: operator precedence, top down, bottom up and reductive strategies. Intermediate forms and symbol tables. Generation and optimization of machine code. Error handling: detection and correction. The run time environment, storage allocation. Prerequisite: 16-228.

16-524 PROGRAMMING LANGUAGES

Staff (3-0)3

An introduction to the formal concepts of programming languages including specification of syntax and semantics. Examination of programming languages (FORTRAN, ALGOL, APL, PASCAL) and string processing languages (SNOBOL). Concepts such as information binding, data storage and mapping and basic control structures are discussed. Prerequisite: 16-228.

16-525 SIMULATION TECHNIQUES

Staff (3-0)3

A study of modern analog, digital and hybrid techniques for the simulation of continuous and discrete systems and processes. The student is expected to study a number of practical engineering systems through the use of simulation techniques on available analog, hybrid and digital computers. Prerequisite: 16-228, 16-445.

16-528 ADVANCED NETWORK ANALYSIS

Staff (3-0)3

Network topology, generation of circuit equations on a loop, nodal, and mixed basis, using matrix algebra. Linear independence and choosing network variables. Tellegen's theorem, reciprocity, and the properties of passive networks. Quadratic forms. Methods of handling mutual inductance, dependent sources, gyrators and the like with Thevenin's theorem, superposition, and other network theorems. Impedance by inspection and the relationship between the natural frequencies of a system and the poles and zeros of the impedance and admittance functions. The phase and magnitude relationships of various filters with precorrection for loss effects, using frequency transformations and Hilbert transforms. Butterworth and Chebyshev filters with magnitude and frequency scaling. Properties and interconnections of two-terminal pair networks and Bartlett's bisection theorem. Prerequisite: 16-362.

16-529 NETWORK SYNTHESIS I

Staff (3-0)3

A review of natural frequencies and analysis techniques; complex variable topics such as conformal mapping, maximum modulus theorem, and Laurent series. Tellegen's theorem. Positive real (p.r.) functions, developed from four different viewpoints, including reflection coefficients. Methods for testing p.r. functions; Hurwitz test, Sturm test, and residue tests. Quadratic forms and the testing for p.r. matrices. Properties of the driving point and transfer immittances of LCT, RCT, and RLT networks, Cauer and Foster network realizations, partial pole removals. Cauer transformations. RLCT Brune realizations. Prerequisite: 16-362.

16-530 NETWORK SYNTHESIS II

Staff (3-0)3

RLCT driving-point synthesis methods of Darlington, Bott-Duffin, Miyata and Fialkow-Gerst. Transfer synthesis methods of Darlington, constant-resistance lattice, RC Ladder. Approximation problems using Butterworth functions, dissipation and predistortion techniques. An introduction to active network synthesis. Prerequisite: 16-529.

16-531 ACTIVE NETWORK SYNTHESIS

Staff (3-0)3

Definition and discussion of active network elements such as controlled sources, impedance converters, and impedance inverters. Synthesis techniques using the negative impedance converter, the gyrator, and the infinite gain

amplifier will be discussed. The application of the various active elements to modern active filter design will be emphasized. Prerequisite: 16-366.

16-537 INTRODUCTION TO BIO-MEDICAL ENGINEERING Staff (3-0)3
A survey of the use of engineering methods in the life sciences. Topics covered include instrumentation techniques and devices, computer diagnosis, artificial organs, prosthetic devices, biological modeling and simulation. Necessary biological background information is introduced as needed. Prerequisite: 16-366.

16-539 BIOLOGICAL SYSTEMS Staff (3-0)3
A discussion to the application of modern control theory to the study of biological systems. Modeling and simulation techniques are emphasized. Necessary biological background information is introduced as required. Prerequisite: 16-413, 16-445, 16-537.

16-543 THEORY OF COMMUNICATIONS Staff (3-0)3
Introduction to information transmission. Representation of deterministic signals in time and frequency domains. Relationship between correlation and power or energy spectra. Introduction to statistical properties of noise. Thermal and shot noise, signal-to-noise ratio, noise figure, and noise temperature. Comparative analysis of continuous and discrete modulation systems; analysis of AM, FM, and various pulse modulation methods (PAM, PPM, PCM) in the presence of noise. Corequisite: 16-509.

16-545 CODING THEORY Staff (3-0)3
Concepts and recent developments in the use of codes for error control in data handling systems. Encoding and decoding procedures and their implementation in computational algorithms and hardware organizations are investigated in detail.

16-547 STATISTICAL COMMUNICATION THEORY Staff (3-0)3
A study of statistical communication problems. Particular topics include the description of signals and noise as stochastic processes, optimum smoothing and prediction and statistical decision theory. Prerequisite: 16-584 or Permission of instructor.

16-548 INFORMATION THEORY Staff (3-0)3
A study of the probabilistic measure of information transmitted by information sources, the determination of the information handling capacity of communication channels and fundamental coding theorems. Prerequisite: 92-584 or permission of instructor.

16-549 INTRODUCTION TO LASERS AND MASERS Staff (3-0)3
A first course on lasers and masers and their applications. Classical electromagnetic theory as well as introductory Quantum Mechanics serve to provide background to engineering students interested in industrial and scientific laser applications. Typical topics include interferometry, liquid crystals and fiber optics, harmonic generation and holography. Prerequisite: 16-362, 16-461, or equivalent.

16-551 ELECTRO-OPTICS Staff (3-0)3
Principles of optical propagation as described by the Fresnel Kirchhoff integral and the Rayleigh integral concept of transform theory of conjugate focal plane of lenses in coherent optical systems, geometrical optics as described by Newtonian lens formulae and principles of holographic three-dimensional wavefront reconstruction. Prerequisites: 16-362, 16-461.

16-561 COMPUTER ORGANIZATION AND DESIGN Staff (3-0)3
A critical examination of the organization of present day digital computers from both the software and hardware points of view. Computer design with hardware-software trade-off. Comparison of instruction sets, their hardware implementation. Examination of the input-output structures of selected examples. Multi-processing and parallel processing. Detailed examination of a large system and of several mini-computers. Students are expected to simulate certain aspects of the example computers on available digital computers. Prerequisite: 16-411, 16-417.

16-562 MICROPROGRAMMING Staff (3-0)3
Microprogramming is introduced as an intermediate hierarchical level between hardware and software. A typical microprogrammable machine such as the HP 21-MX is used. A detailed study is made of data paths, timing rules, control commands available to the programmer, and what modifications and tests are performed in the process. Micro-programs are written in both machine language and in the microassembly language and are debugged

interactively using the MICRO-DEBUG EDITOR. Previously written micro-language programs are reviewed and the least efficient segments are rewritten in micro-code so that execution times are reduced. User's function codes are developed to further illustrate the efficacy of writable control store operations in the extension of the computer microinstruction set. Emphasis is placed on the fact that microinstructions have access to many internal registers and logical functions that the Main Memory programs cannot use. Prerequisite: 16-417.

16-563 SYSTEM PROGRAMMING

Staff (3-0)3

The definition of system programming as programming in a multiuser environment. Programming with and for interrupts. Reentrant programming, pure procedures. Communication between program modules. Nested calls, the push-down stack. Recursive program calls. Reentrant interrupt programming. Activation records and program sharing. Memory allocation by absolute and relocatable loaders. Macro languages, macroprocesses and introduction to assemblers and macro assemblers. Prerequisite: 16-417.

16-564 OPERATING SYSTEMS

Staff (3-0)3

The resources of a large computer system. Sequential and concurrent processes in large digital computers. Design objectives: Program sharing, Multi-processing, Memory-sharing and protection. Process communications and critical processes in operating systems. Scheduling. Paging, Segmenting and swapping strategies. Time sharing and multiple-task operating systems. Design and simulation of operating system behavior. Operating system performance evaluation. Prerequisite: 16-417.

16-571 INTRODUCTION TO RADAR SYSTEMS

Staff (3-0)3

Introduction to both pulsed and C. W. radar systems. Detection of radar echoes in noise. The radar equation and its use in estimating performance of a radar system. Estimation of range, direction and velocity of targets. Moving target indicators (MTI). Pulse compression and other advanced techniques. Discussion of elements of practical radar systems. Prerequisite: 16-439 or 16-543.

16-572 INTRODUCTION TO MICROPROCESSORS

Staff (3-0)3

Microprocessor models are introduced and comparisons of the internal architecture of available microprocessors are studied. Bus architecture, timing diagrams, loading considerations, the instruction set, etc., are studied using a currently available microprocessor as an example. Support chips such as priority interrupt controllers, DMA, A/D, D/A, and programmable peripheral-interface units will be examined. Current applications of microprocessors will be studied. Prerequisites: 16-417, 16-575, 16-412 or permission of instructor.

16-574 INTRODUCTION TO DIGITAL SYSTEM DESIGN

Staff (3-0)3

A review of combinatorial and sequential circuit concepts at both the bit and register levels, number systems, binary adders, shift registers, and memories. The definition of a basic set of control operations and data modules that are used to develop a register-transfer-level language which is used to flowchart and document design algorithms. Computer-assisted simulations, using SIMRIM are conducted to assist in an evaluation of the cost, performance, and adaptability of each design algorithm. Applications include asynchronous processing, parallel processing, stacks, queues, microprocessing, special purpose processors, and microcoded processors. Prerequisite: 16-411, 16-417.

16-575 DIGITAL SUBSYSTEM DESIGN

Staff (2-2)3

An overview of the design process developed in 16-574 with emphasis on developing algorithms at the register transfer level, decomposition of these algorithms into detailed RTL flowcharts showing registers, transfer paths, control and timing paths. Selected flowcharts are converted to a detailed wiring diagram for wire-wrap testing and study. A hardware term project is required of each student, constructed from the available register transfer module family along with a complete report detailing the scope and purpose of the algorithm. Prerequisite: 16-574.

16-577 STATE VARIABLE ANALYSIS OF SYSTEMS

Staff (3-0)3

Algebra of matrices, vector spaces, and linear transformations. Calculus of matrices, matrix functions and the solution of differential and difference equations as formulated by the state variable characterization of systems. A consideration of canonical forms for computer simulation. Prerequisite: 16-362.

16-581 ELECTRODYNAMICS

Staff (3-0)3

The focus of this course is the transient analysis of electromechanical devices, including electromechanical transducers and ac and dc machines. Topics covered include stored electric and magnetic energy, electric and magnetic forces, dynamic models of electromechanical devices, solution of differential equations to obtain equations of motion, driving point impedances, transfer functions for linear devices, and methods of approximation

for non-linear devices. Applications covered include magnetic transducers, piezo-electric transducers, transient analysis of power systems, and the formulation of mathematical models of servo-mechanism components. Prerequisite: 16-355.

16-601 SEMINAR IN ELECTRICAL ENGINEERING

Staff (3-0)3

The purpose of the seminar is to provide students in the nonthesis option with the opportunity to satisfy the requirement of making a scholarly oral presentation before a group in this field, primarily composed of his class and instructor. Early in the course student proposals will be heard and, if necessary, modified or redefined. Acceptable subjects will include but will not be limited to selected topics in the general field of electrical engineering, lucid descriptions and reviews of compactly written technical journal articles, individual or original topics. Each student will be judged on his/her clarity of exposition, knowledge of subject, ability to clearly and effectively answer questions, as well as participation in the discussions of other papers. Letter grades will be issued (A, B, C, etc.). The class size will be limited to ten students and will meet 3 hours per week for one semester. Prerequisite: Minimum of 15 credit hours of graduate courses.

16-651 SELECTED TOPICS IN ELECTRICAL ENGINEERING

Staff (3-0)3

Advanced topics in various areas of electrical engineering and related fields. Since topical coverage varies from term to term, a student may be allowed to receive credit more than once for this course. Prerequisite: Specified at the time of a particular offering.

16-701 GRADUATE RESEARCH IN ELECTRICAL ENGINEERING

Staff (0-9)6

Analytical and/or experimental work conducted under the supervision of a faculty member of the Department of Electrical Engineering leading to a written report in the form of a thesis, an oral presentation, and a defense of this thesis on some problem in the area of electrical engineering. Prerequisite: Minimum of 15 credit hours of graduate courses.

12-701 GRADUATE RESEARCH IN COMPUTER ENGINEERING

Staff (0-9)6

Analytical and/or experimental work conducted under the supervision of faculty member of the Department of Electrical Engineering leading to a written report in the form of a thesis, an oral presentation, and a defense of this thesis on some problem in the area of computer engineering. Prerequisite: Minimum of 15 credit-hours of graduate courses.

28-701 GRADUATE RESEARCH IN SYSTEMS ENGINEERING

Staff (9-0)6

Analytical and/or experimental work conducted under the supervision of a faculty member of the Department of Electrical Engineering or perhaps another department in the case of an interdisciplinary program, leading to a written report in the form of a thesis, an oral presentation, and a defense of this thesis on some problem in the area of systems engineering. Prerequisite: Minimum of 15 credit-hours of graduate courses.

DEPARTMENT OF INDUSTRIAL TECHNOLOGY

Chairperson: Frank Alberti

Associate Professors: Frank Alberti, Jack Apfelbaum, Bernard Harcourt

Assistant Professors: D.A. Colling, Anthony Cirrito, Lawrence Maloney, Nancy Miu, William Smorczewski, G. Lawrence Thatcher

The Industrial Technology program prepares students for professional careers in such rapidly expanding fields as production, manufacturing, and operational systems. The program, which is designed to increase the variety of educational opportunities available to students who wish to pursue careers which encompass a broad spectrum of activities ranging from engineering science to business administration, is offered with emphasis on manufacturing and production techniques.

Industrial Technology graduates from the program, by drawing upon both theoretical knowledge and industrial skill, will be in a position to direct manufacturing operations, establish and supervise production procedures, supervise managerial aspects of modern industry and institutions. The majority of the graduates enter directly into industry. A small but significant number pursue graduate study in such fields as manufacturing engineering, industrial engineering, business administration, health care and delivery systems.

A significant feature of the program is the possibility to incorporate supervised industrial experience for academic credit. This experience, together with the theoretical and applied background provided by the University, will make the graduate flexible and capable of adapting to a wide variety of industrial organizations and problems.

The curriculum is a formally organized program which provides a well-balanced education. Approximately forty percent of the curriculum pertains to technical subjects, including methods for measurements, numerical and automatic control, manufacturing processes and operations. Twenty percent pertains to business subjects; twenty percent to the social sciences and humanities, and the balance to mathematics and sciences. Sufficient electives are provided to permit students to round out their primary interests or pursue their personal goals.

Because students in Industrial Technology aspire to a variety of professional careers, the department maintains a flexible transfer credit policy. A student without transfer credit or advanced standing will take an average of 16 credits per semester.

The Industrial Technology program is accredited by the National Association of Technology (NAIT).

COURSE OF STUDY FOR INDUSTRIAL TECHNOLOGY#

Freshman Year

Fall Semester

20-112 Mach. Tool Proc.	
42-101 College Writing	3
64-201 Economics I	3
84-111 Gen. Chemistry	4
84-113 Gen. Chem. Lab	1
92-121 Pre-Calc. Math.	3
Phys. Ed.	
	17

Spring Semester

00-101 Perspectives in Eng.	1
20-105 Intro. Mech. Design	3
42-102 College Writing II	3
47-101 Gen. Psychology	3
95-151 Elem. Physics	4
96-151 Elem. Physics Lab	1
92-122 Diff. Calculus	3
Phys. Ed.	
	16

Sophomore Year

Fall Semester

20-201 Intro. of Materials	4
20-205 Mechanics	4
42-225 Tech. & Sci. Writing	3
92-201 Integral Calculus	3
Area II Elective	3
	16

Spring Semester

20-208 Advanced Materials	3
66-253 Org. Behavior	3
20-202 Indus. Comp. Sci.	3
92-383 Intro. to Statistics	3
Area II Elective	3
	15

Junior Year

Fall Semester

16-290 Indus. Electricity	3
16-291 Indus. Elec. Lab.	1
20-307 Fluid Power Controls	3
20-310 Indus. Safety	3
66-371 Operation Mgt. I	3
60-201 Accounting I	3
	16

Spring Semester

20-308 Indus. Elct.	4
20-305 Mfg. Processes	3
20-314 Motion & Time Study	3
26-211 Plast. Mat. Sci.	3
20-311 I.T. Seminar	1
Area I or II Elective	3
	17

Senior Year

Fall Semester

20-407 Inst. & Proc. Control	4
20-414 Indus. Econ. Mgt.	3
Tech. Elect. or Co-op	3
Tech. Elect. or Co-op	3
Gen. Elect. or ROTC	3
	16

Spring Semester

20-402 Mfg. Operations	3
20-416 Stat. Qual. Control	3
66-321 Marketing Princ.	3
Tech. Elect. or Co-op	3
Gen. Elect. or ROTC	3
	15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Industrial Technology (Course Prefix: 20)

20-105 INTRODUCTION TO ENGINEERING DESIGN

I(2-2)3

A course to introduce students to industrial practice in design graphics, orthographics projection, sectioning, limit dimensioning, gear trains, cams and fasteners. A mechanical design problem completes the semester's work.

20-112 MACHINE TOOL PROCESSES

II(2-2)3

An introduction to fundamental machine shop techniques; covering machining, practice, measurement and layout, and general shop safety. The objective is to develop an appreciation for basic machine tool practices utilized in manufacturing and in industrial maintenance and repair activities; and knowledge of process and tooling specification for operations planning. Practical exposure enhances ability to communicate concepts, regarding maintenance, prototype and production projects. Prerequisite: 20-105 or equivalent.

20-113 INTRODUCTION TO MACHINE TOOLS

I(1-1)1

A compressed survey of basic machine shop techniques including measurement, and inspection, with the objective to develop a basic understanding of these processes for product engineering and design communications. Laboratory experience centers on conventional machining. For Mechanical Engineering majors only, or permission of instructor.

20-201 INTRODUCTION TO MATERIALS

I, II(3)4

A practical study of the relationship between properties, composition and structure of metals. This course includes selection, crystal structure, alloy phase diagrams solidification and heat treating principles of metals as well as their application in normal and extreme environmental conditions. Laboratory investigations reinforce lecture material, but emphasize testing procedures for materials.

20-202 INDUSTRIAL COMPUTER SCIENCE

II(3-0)3

An introduction to the use of computers in industry by programming COBOL and FORTRAN languages. Ten programs are required to be designed and run by the students. Problems include I/O, min-max, branching, arrays, matrices, plotting, subprograms, and major inventory type problem.

20-203 INDUSTRIAL POWER TRANSMISSION

II(2-2)3

An introduction to the design or selection of mechanical elements used in the transmission of power in industrial equipment. Elements considered include shafts, pulleys, gears, gear trains, bearings, clutches, brakes and springs. Prerequisite: 20-204 or equivalent.

20-205 MECHANICS

I(4-0)4

An introduction to the mechanics of solids. The free-body mode of equilibrium analysis and dimensional consistency in basic dimensions are fostered throughout the course. Material stresses and strains and structural reflections resulting from torsional and other forces are analyzed for basic design applications. The effect of fluid pressure on structural strength is created as well as its functions in the transmission of power. Prerequisite: 95-151.

20-206 ENERGY CONVERSION TECHNOLOGY

I,II(3-0)3

Fossil fuel, solar, wind and other energy sources are converted to mechanical energy and the production of electricity with special emphasis on heat utilization. Included is a simplified study of thermodynamics with respect to engine cycles, steam generation, refrigeration and heat pumps. Heat utilization relates to heat transfer including conduction, convection and radiation. Gas laws and water-vapor mixtures essential to the above studies are reviewed.

20-208 ADVANCED MATERIALS

II(2-2)3

This course is a continuation of the study of materials, emphasizing joining methods and deformation processing of metals. In addition, ceramics, concrete, composite materials and powder metal processing are considered. Laboratory studies include: soldering, adhesives, welding in addition to testing procedures. Prerequisite: 20-201.

20-305 MANUFACTURING PROCESSES

I,II(2-2)3

This course is a continuation of Machine Tool Processes. Course work entails introduction to nonconventional machining such as Electrical Discharge Machining, lasers and the various forms of chemical and electro-mechanical operations to the fundamentals of numerical control manufacturing and robotics. The objective is to develop a broader understanding of manufacturing operations and product design/manufacturing relationships. Laboratory experience includes nonconventional machining, and numerical control operations and programming. Prerequisites: 20-105 and 20-112.

20-307 FLUID POWER CONTROLS

I,II(2-2)3

Laboratory experience and lectures on the elements of hydraulic and pneumatic power systems, and the automatic control of these systems. Systems elements studied are actuators, valves, power sources and accessories. Control systems studied are pneumatic, electronic and fluidic logic, electrical solenoid and relay control circuits are designed.

20-308 INDUSTRIAL ELECTRONICS

II(3-2)4

The study of electron flow, semi-conductor, devices, diodes, transistors, rectifiers, operational amplifiers, logic devices, printed circuits and chips. Extensive work with diagrams and the use of instruments, meters, signal generators and oscilloscopes.

- 20-309 INDUSTRIAL ACCOUNTING** (3-0)3
Basic accounting principles, cost accounting theory and procedures; their use in manufacturing and other industries.
- 20-310 INDUSTRIAL SAFETY** (3-0)3
A practical study of industrial safety and accident prevention. Studies include hazard analysis, safety management, engineering remedies and risk management. Numerous practical cases are presented and the roles of governmental agencies in safety are analyzed.
- 20-311 INDUSTRIAL TECHNOLOGY SEMINAR** (1-0)1
Designed to help each student gain a high level of proficiency in the presentation of technical material. A series of oral and visual reports given before classmates and I.T. Faculty. Critical responses and closed circuit television are used to improve presentations.
- 20-314 MOTION AND TIME STUDY** (3-0)3
Methods improvement and work measurement techniques, including principles of motion economy, work simplification, process and operator charts, work sampling, linear regression and time standards. Prerequisite: Junior standing.
- 20-402 MANUFACTURING OPERATIONS** II(2-2)3
This course is organized so that students can design the manufacturing process and fabricate a product for small quantity production. Accompanying lectures cover pertinent subject areas such as: forecasting, plant layout, materials handling, per/cost, product evaluation and equipment selection. Several plant trips and outside speakers are usually scheduled. Prerequisites: Senior standing.
- 20-407 INSTRUMENTATION AND PROCESS CONTROL** I(3-2)4
An introduction to process control system technology. Liquid level, rate of flow, pressure and temperature measuring devices and their characteristics. R-C of system components. Integral, dead-time and first order lag processes. Control modes. Bode diagrams and frequency response. Prerequisite: 16-290, 16-291.
- 20-414 INDUSTRIAL ECONOMIC MANAGEMENT** I,II(3-0)3
Analysis of available alternatives in equipment, plant and materials purchasing or leasing. Economic feasibility analysis of industrial projects including depreciation techniques, breakeven analysis, benefit-cost techniques, replacement, present worth and rate of return analysis. Prerequisite: 20-309 or equivalent.
- 20-416 STATISTICAL QUALITY CONTROL** I,II(3-0)3
A study of the statistical and administrative techniques relative to the maintenance of product quality at defined levels. Sampling plans for variables and attributes are considered from the viewpoint of consumer vendor relationships and economics. Prerequisites: 92-383 or equivalent, 20-105, 20-112, 20-305.
- 20-423 PRODUCT LIABILITY** (3-0)3
Product liability has become of increasing importance to industrial engineers due to legal decisions involving direct placement of liability for safe products on original manufacturers, and on individual responsible engineers. In this course, the legal aspects of negligence, strict and implied liability will be developed and the role of engineers in designing, manufacturing and testing reasonable safe products will be defined. The role of government agencies such as the Consumer Product Safety Commission and reference sources for product liability literature will be examined. Numerous product liability cases will be reviewed with specific examples on investigative techniques utilized to prove liability for failure.
- 20-424 ELECTRONICS MANUFACTURING** II(3-0)3
This course provides the student with an overview of those aspects of manufacturing which are uniquely encountered in the electronics industry. Relationships between product design and production processes are explored in areas such as components, including solid state decodes, printed wiring board assemblies, and overall electronic equipment packages. Prerequisites: 16-290, 20-208, and 20-308.
- 20-425 VALUE ENGINEERING** I(2-2)3
Value Engineering is a cost and design discipline aimed at achieving the necessary functions of products or services at minimum cost. Using case studies, laboratory design work and lectures the principles and methods of Value Engineering are presented and then applied to practical problems. Prerequisite: Senior standing.

20-426 PRODUCTION OPERATIONS MANAGEMENT

11(3-0)3

This course focuses on production from capacity planning and human behavior standpoints. A series of case studies will be analyzed and discussed. Group projects involving setting up actual production lines will be performed. Subjects covered include inventory control, economic order quantity, ABC analysis, job shop production line analysis, flow diagramming, marketing and financial analysis. Guest lecturers from industry and plant tours will be integrated into the course as opportunity allows.

20-428 METHODS-TIME MEASUREMENT

(3-0)3

The principles, data and techniques for applying Methods-Time measurement in manufacturing and their application in evaluating existing methods, synthesizing new improved methods and tool designs, estimating production costs and providing standard data and time formulas. Prerequisite: 20-314.

20-491 (20-492) SPECIAL PROJECTS

1,11(1-4)3

Directed industrial experience in planning, executing and reporting of an individual project selected by the student in consultation with a faculty member of the Industrial Technology department. Prerequisite: Senior standing.

DEPARTMENT OF MECHANICAL AND ENERGY ENGINEERING

Chairperson: Zelman Kamien

Professors: Frederick Bischoff, Gilbert Brown, William Hogan, Robert Hollenbach, Jose Martin, John McElman, Alan Mironer, John O'Callahan, James Phelps, Kenneth Rogers, Steven Serabian, G. Dudley Shepard.

Associate Professors: James Flanagan, Zelman Kamien, William Kyros, Eugene Niemi, Jr., James Sheff.

Assistant Professors: Arthur Petrou, Woon-Shing Yeung, Yakov Zilberberg.

Instructors: Roy Richard, John R. White.

Mechanical Engineering

Because Mechanical Engineering is a diversified professional activity involving the development of new methods of energy production and conversion, transportation, manufacture, and fabrication, it is not possible for a student to master the entire field during a four-year program. Thus, the objective of the Mechanical Engineering curriculum is to provide a broad fundamental base from which graduates can go on to develop their skills by entering general engineering practice or pursuing an advanced engineering degree.

Mechanical Engineering Program

The first component of the curriculum consists of courses in the humanistic-social studies and the basic sciences. The purpose of this component is to broaden the student's outlook, to provide a firm understanding of fundamentals, to develop analytical techniques, and to prepare for specific technical studies.

The second component of the curriculum consists of courses which provide knowledge in a coherent area of engineering science. The purpose of this component is to form a link between the basic sciences and engineering and to introduce the methodology of engineering analysis, design, and synthesis. Three areas of engineering science have been selected for this component: solid mechanics, statics, dynamics, and mechanics of materials), thermaltransport (thermodynamics, fluid mechanics, and heat transfer), and dynamic systems (electricity, electronics, systems, and automatic controls).

The third component of the curriculum consists of advanced problems and topics in engineering design and requires the utilization of knowledge from the first two curriculum components. The purpose of the design activity is to develop skill in the use of science and creativity in the solving of engineering problems.

A variety of laboratory work is included in the curriculum in order to demonstrate the use of the experimental method in the solution of engineering problems. To permit a degree of specialization, technical electives are provided. A staff advisor system is used in order to aid the student in selecting technical electives which will be consistent with the future career plans of the student. This curriculum is accredited by the Accrediting Board for Engineering and Technology (ABET) (formerly the Engineers' Council for Professional Development).

Five Year Master of Science Program

- I. For students wishing to pursue the five year BS/MS program, the first three years of course work is the same as that specified for students in the four year Bachelor's program.
- II. In the senior year, the following modifications are involved;
 - Students should take one graduate course per semester.
 - Students should start their preliminary work on the thesis, and this work will also satisfy the senior project course requirements (22-407 and 22-408).
 - The thesis advisor acts as the senior project supervisor.
 - The students receive their B.S. degree after completing their senior year.
 - In the fifth year, students take three graduate level courses per semester as well as 3 thesis credits per semester.

COURSE OF STUDY FOR MECHANICAL ENGINEERING#

Freshman Year

Fall Semester

00-101 Perspectives in Eng.	1
*84-121 Chemistry	3
*84-123 Chem. Lab.	1
42-101 College Writing 3	42-101 Coll. Writing & Lit. 3
92-131 Calculus B-I or	
92-133 Calculus A-I	4
Phys. Ed.	
92-263 Computer Programming	3
20-113 Intro Mech. Tools	1
	16

*84-135 Honors Chem. and, 84-137
Honors Chem. Lab. may be substituted.

Spring Semester

*84-122 Chemistry	3
*84-124 Chem. Lab.	1
921-132 Calculus B-II or	
92-134 Calculus A-II	4
95-145 Physics I	4
96-145 Fund. Exp. Phys. I	1
Phys. Ed.	
	16

*84-136 Honors Chem. and 84-138
Honors Chem. Lab. may be substituted.

Sophomore Year

Fall Semester

16-211 Fund. of Elct.	3
92-231 Calculus B-III or	4
92-233 Calculus A-III	3
95-146 Fund. Exp. Phys. II	1
22-211 Mechanics I	3
22-295 Material Science	3
	17 or 18

Spring Semester

16-212 Intro. Electronics	3
92-234 Diff. Equations	3
22-221 Intro. Mech. Design	3
22-242 Thermodynamics	3
42-225 Tech. Sci. Writing	3
	18

Junior Year

Fall Semester

64-201 Economics I	3
92-301 Adv. Calc. for Appl.	3
22-313 Dynamics I	3
22-381 Fluid Mechanics	3
22-321 Machine Design I	3
Area I or II Elective	3
	18

Spring Semester

62-202 Economics II	3
22-302 Mech. Eng. Lab I	2
22-244 Heat Trans.	3
22-354 Mech. Vibrations	3
Math Elective	3
Area I or II Elect.	3
	17

Senior Year

Fall Semester

22-403 Mech. Eng. Lab. II	2
22-441 Anal. Thermo. Fld. Syst	3
Design Elective	3
Area I or II Elective	3
ROTC or Undergraduate Elective	3
22-453 Dynamic Sys. Control	3
	17

Spring Semester

Tech. Elective	3
Design Elective	3
Tech. Elective	3
Area I or II Elective	3
ROTC or Undergraduate Elective	3
	15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Nuclear Engineering

Program Coordinator: James P. Phelps

The Nuclear Engineering Program provides each student with a sound foundation for a professional career in any aspect of the nuclear field. The central emphasis is upon the engineering, mechanics and physics principles underlying nuclear power systems.

Students are given a thorough foundation in engineering science, engineering design, mathematics, and the basic sciences. Experimental techniques are demonstrated through investigative work by the student in various laboratories, and analytical techniques are enhanced through integration of computer use in various courses.

Members of the Department recognize that nuclear energy, in particular, and energy technology, in general, are manifestations of diverse specializations. Accordingly, a wide range of approved technical courses are available as technical and design electives. In general, the Department recommends that electives be concentrated in one of the following areas: general nuclear engineering, fission power systems, fusion power systems, solar power systems, geothermal power systems, or materials. This curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET).

A 5 year program leading to both a BA and BS degree is available.

COURSE OF STUDY FOR NUCLEAR ENGINEERING#

Freshman Year

Fall Semester

00-101 Perspectives in Eng.	1
*84-121 Chemistry	3
*84-123 Chem. Lab.	1
42-101 College Writing 3 42-102 Coll. Writing & Lit.	3
92-131 Calculus B-I or	
92-133 Calculus A-I	4
+ 95-141 Physics I	3
+ 96-141 Fund. Exp. Phys I	1
Physical Education	
	16

Spring Semester

*84-122 Chemistry	3
*84-124 Chem. Lab.	1
92-132 Calculus B-II or	
92-134 Calculus A-II	4
+ 95-144 Physics II	3
96-144 Fund. Exp. Physics II	1
Physical Education	
	15

*84-135 Honors Chem. and 84-137	
Honors Chemical Lab.	
+ 95-147 Honors Physics & 95-147	
Fund. of Exp. Physics I may be substituted.	

*84-136 Honors Chem. and 84-138	
Honors Chemical Lab.	
+ 95-148 Honors Phys. & 96-148	
Fund. of Exp. Physics II may be substituted.	

Sophomore Year

Fall Semester

16-211 Fund. of Electricity	3
92-231 Calc. B-III	4
	or
92-233 Calc. A-III	3
80-201 Phys. of Radiation	3
92-261 Intro. to Fortran	2
24-204 Seminar in Nuc. Eng.	1
Hum. Soc. Elective	3
64-201 Economics I	3
	18 or 19

Spring Semester

92-234 Differential Equa.	3
80-202 Phys. of Nuc.	3
22-214 Mechanics	4
24-201 Drawing & Blueprint	2
22-242	
	or
24-242 Thermodynamics	3
24-231 Nuc. Inst. I	1
Hum. Soc. Elective	3
	19

Junior Year

Fall Semester

92-301 Adv. Calc.	3
24-301 Reactor Phys. I	3
22-381 Fluid Mech.	3
80-305 Nuc. Inst. II	4
64-202 Econ. II	3
Hum. Soc. Elective	3
	19

Spring Semester

92-302 Adv. Calc.	3
24-302 Reactor Phys. II	3
	or
24-344 Heat Transfer	3
24-397 Num. Meth in NE Des.	3
16-232 Electromechanics	3
Hum. Soc. Elec.	3
	18

Senior Year

Fall Semester

24-401 Power Syst. Eng. I	3
24-403 Reactor Opn. & Lic.	3
24-416 Intro to Fusion Res.	3
Tech Elective	3
*Undesignated Elect.	3
	15

Spring Semester

24-402 Power Syst. Eng. II	3
24-404 Reactor Design	4
Tech Elective	3
*Undesignated Elec.	3
	16

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*ROTC students may subst. 29-401

*ROTC students may subst. 29-402.

Mechanical Engineering (Course Prefix: 22)

22-201 GRAPHICS

I(1-0)1

The technique of communicating engineering information and concepts by means of orthographic drawings, pictorial views and sketches. Charts, graphs, gear design, fundamentals of descriptive geometry.

22-211 MECHANICS I

I(3-0)3

The application of Newton's Laws to engineering problems in statics. The free-body diagram method is heavily emphasized. Topics include: vector algebra; force; moment of force; couples; static equilibrium of rigid bodies; truss analysis; friction; properties of areas; shear and moment diagrams. Prerequisites: 92-132 or 92-134, 96-145.

22-212, (22-220) MECHANICS OF MATERIALS I

II(3-0)3

Stress and deformation analysis of bodies under axial, torsional, flexural and combined loading; failure loads, buckling. Prerequisites: 92-231 or 92-233; 22-211.

22-214, (22-212) ENGINEERING MECHANICS

II(4-0)4

A one-semester terminal course with emphasis on the engineering aspects of mechanics. Topics include: vectors, static equilibrium; rigid and deformable solids, stress and strain under various loading conditions; mechanical properties of materials. Applications of Newton's second law including momentum and energy. Particle and rigid body motion; vibrations and electric analog; central force motion; collision. Prerequisites: 95-145, 92-234 (concurrently).

22-221, (22-205) INTRODUCTION TO ENGINEERING DESIGN

I(2-3)3

Lecture topics include: orthographic projection, dimensioning, detailing, standard parts and procedures used in the design of gear reducers, welded structures, and castings. The students' vocabulary of mechanical design is developed by laboratory drawing exercises involving cams, gears, shafts, bearing, etc. A term design project is assigned to provide the student with a comprehensive experience in layout design during the latter half of the term. Prerequisite: 20-271.

22-242 THERMODYNAMICS

II(3-0)3

Thermodynamic properties of pure substances, condensable vapors, and the perfect gas. Work and heat. Detailed development of the First and Second Laws for systems and control volumes; steady and unsteady processes. Concept of entropy, reversibility, and irreversibility. Application to vapor power and refrigeration cycles. Prerequisites: 92-231 or 92-233, 95-145.

22-295 MATERIALS SCIENCE

I(3-0)3

Materials for use in engineering applications are presented in terms of their general mechanical behavior, the thermodynamics of their structures, and their properties as related to their atomic and crystalline structure. The specific differences and similarities between metals, polymers and ceramics are emphasized. Prerequisites: 84-122, 95-145.

22-302 MECHANICAL ENGINEERING LABORATORY I

II(0-3)2

A series of laboratory exercises designed to illustrate and amplify principles presented in Mechanics of Materials I, Materials Science, and Dynamics I. Prerequisites: 22-212, 22-295, 22-313.

22-313, (22-309) DYNAMICS I

I(3-0)3

Vector development of kinematics of a particle with respect to fixed and moving coordinate systems of one, two, and three dimensions. The dynamics of a particle, system of particles, and rigid bodies. Angular momentum and the inertial properties of rigid bodies. Energy, impulse and momentum. Prerequisites: 92-232, or 92-234; 22-211.

22-315 APPLIED MECHANICS

I(3-0)3

The fundamentals of statics, including such topics as force systems, laws of equilibrium, friction, centers of gravity, moments of inertia, and the introduction to dynamics. Prerequisites: 92-132 or 92-134; 95-145, 96-145 or equivalent. (Primarily for IM students).

22-317, (22-372) STRENGTH OF MATERIALS

II(3-0)3

The fundamentals of stress, including such topics as torsion, axial force, shear, bending moment, combined stresses. Prerequisite: 22-315 (Primarily for IM students).

22-321, (22-320) MACHINE DESIGN I

I(3-0)3

The principles of mechanics and commonly used theories of failure are applied to the design and analysis of typical machine elements subjected to various loading conditions. Prerequisite: 22-212.

- 22-344, (22-343) **HEAT TRANSFER** II(3-0)3
Theory and application of steady and transient heat conduction in solids. Mathematical development of hydrodynamic and thermal boundary layer theory. Forced convection, natural convection, heat exchangers. Development of thermal radiation with application to heat exchange between non-black bodies. Prerequisites: 22-242 or 22-347; 22-381.
- 22-346, (22-344) **HEAT AND POWER** II(3-0)3
The principles of thermodynamics, properties of steam and its utilization in manufacturing processes, and a brief treatment of power plants and heating and ventilating equipment. Prerequisites: 92-132 or 92-134. (Primarily for IM students).
- 22-347 **ELEMENTS OF THERMODYNAMICS AND HEAT TRANSFER** I,II(3-0)3
Development of the concept of energy and the thermodynamic properties of matter. Energy and mass transfer between a system and its surroundings. Conservation laws for Energy and Matter. Second Law of thermodynamics and the property of Entropy. Heat transfer: steady state conduction, convection and radiation. Application to energy transfer and conversion devices.
- 22-354 **MECHANICAL VIBRATIONS** I(3-0)3
Development of the equations of motion for single and multidegree of freedom systems using energy and force/moment techniques. Steady state and transient response analysis of the second order systems via classified and numerical techniques. Interactive computer studies of mechanical systems using program VIBS. Prerequisites: 92-301, 22-313.
- 22-381, (22-382) **FLUID MECHANICS** I,II(3-0)3
Development of basic fluid mechanical relations; continuity, and Bernoulli equations. Emphasis on control volume approach to problem solving. Hydrostatics, internal flows, Reynolds number. External flows, boundary layer concept, separation, fluid dynamic drag. Angular momentum principles with application to turbomachinery. Prerequisites: 22-212, 22-242. Corequisite: 92-301.
- 22-403 **MECHANICAL ENGINEERING LABORATORY II** I(0-3)2
Experiments performed on equipment in the Mechanical Engineering Laboratory and covering generally the areas of Thermodynamics, Fluid Mechanics, Heat Transfer and Controls. Participants are encouraged to analyze experiments with application to previously taught principles. Emphasis is placed on data acquisition and analysis and proper presentation in and Engineering Report. Prerequisites: 22-242, 22-344, 22-381. Corequisites: 22-441, 22-453.
- 22-405, 22-406 **ADVANCED PROJECT: SYSTEMS & DESIGN I & II** (0-6)3,(0-6)3
A project in advanced engineering design is structured to provide learning experience in the application of the design process on a scale and in a format similar to that in industry. A strong emphasis is on the integration of economic, political, sociological, human factors and the non-technical concepts into the engineering design process. An interdisciplinary student design team is organized to engineer a complex product or system design from conception to construction and fabrication. The team is called upon to utilize all of the engineering skills learned as an undergraduate including communication, analytical, design and humanistic-social knowledge. Prerequisite: 22-205, Senior status and permission of instructor.
- 22-407, (22-409) **SENIOR PROJECT I** I(0-3)1
Direct engineering experience in planning, executing and reporting of an individual project selected by student in consultation with the M. E. Staff Members. The first team is devoted to problem definition, solution synthesis and design analysis. Prerequisite: Senior status.
- 22-408, (22-410) **SENIOR PROJECT II** II(0-6)2
A continuation of 22-407. The second team is devoted to trade off and optimization, construction, testing, evaluation and reporting. Prerequisite: 22-407.
- 22-412, (22-473) **MECHANICS OF MATERIALS II** I,II(3-0)3
The state of stress at a point; theories of failure by yielding; energy methods, shear center, unsymmetrical bending; curved flexural members, torsional resistance in non-circular sections, photoelasticity. Prerequisites: 92-301, 22-212.
- 22-413, (22-417) **DYNAMICS II** I,II(3-0)3
Generalized coordinates and Lagranges' Equations. Solutions to both linear and non-linear one degree-of-freedom mechanical systems, phase plane technique. Multi-degree-of-freedom systems. Prerequisite: 22-354

22-421 COMPUTER AIDED DESIGN

I,II(2-3)3

Emphasis is placed on the use of Applicon's AGS 880 3D Graphics system and its extension to the solution of engineering design problems. The course exposes the student to the range and limitations of existing graphics/design computer systems, while giving each a working knowledge of a specific "turn key" system. Prerequisite: Senior standing or permission of instructor.

22-422 MACHINE DESIGN II

I,II(3-0)3

A continuation of 22-321. Laboratory problems emphasized aspects of the overall design processes; the use of the layout tool in machine design; the compromise between theoretical and practical considerations; optimum design criteria. Prerequisite: 22-231.

22-423 DESIGN OF AUTOMATED THERMOHYDRAULIC SYSTEMS

I,II(3-0)3

Brief review of the fundamentals of system modeling and control. System compensation methods and principles of feedback design. Synthesis of a closed loop automatic control system. Static and dynamic characteristics of typical first and second order thermohydraulic systems. Guidelines for selection of instruments and automatic control devices. Electric, pneumatic, and hydraulic means of automatic control-design background (Boolean algebra, fundamentals of fluids, etc.) Development and presentation of design projects of some specific Automated Thermohydraulic Systems, e.g. Thermal power generating system, heating system; refrigeration or heat pump unit; hydraulic or pneumatic power supply systems, etc. Prerequisite: Senior status.

22-424 CASE STUDIES IN DESIGN

I,II(3-0)3

The case study method is used to give the student exposure to design problems and processes encountered in industry. Cases encompass a wide range of engineering and business considerations including: creative design and conceptualization, design methods, product design, materials selection, human factors, value engineering, design optimization, design for production, design for consumer appeal, design program planning, inventions and patents, product costing and pricing. Comprehensive overall design approach to real problems is emphasized; followed up with inspection, discussion and critique of the product as it was actually designed. Prerequisite: Senior status.

22-425 DESIGN OF EXPERIMENTAL SYSTEMS

I,II(3-0)3

Theory and practice of designing experiments and the systems required to implement the entire experimental program. Areas include: experimental planning, statistical methods for design and analysis, instrumentation system design, instrument selection, data acquisition systems, microprocessor control and analysis, design of test hardware and fixturing. Case studies' laboratory demonstrations and term project. Prerequisite: Senior status.

22-426 DESIGN INNOVATION

I,II(2-2)3

A projects oriented course which stresses the design, analysis, fabrication and testing of student devices. Each design project is used to reinforce lecture material or core curriculum basics. Lecture topics include, the phases of design, idea generation, PERT, decision analysis, human factors, patent law and design economics. Prerequisites: 22-221, 22-321.

22-427 DESIGN OF AUTOMATIC MACHINERY

I,II(3-0)3

Basic system approach to the design of automatic machinery emphasizing selection and integration of standard components and controls. Fundamentals of pneumatic, relay and microprocessor controls applied to pneumatic, electro-mechanical and mechanical sensing and actuating components. Basics of parts handling positioning, assembly, automatic inspections and test in small (less than 5 HP) machinery system. Prerequisite: Senior status.

22-428 HUMAN FACTORS IN ENGINEERING DESIGN

I,II(3-0)3

The design constraints imposed on man-made objects and environments by human mental and physical limitations will be explored by literature study and lectures. Student ideas for designs will be developed in the form of detailed engineering proposals which reflect optimum solutions to man-machine interface problems. Prerequisite: Senior status.

22-433, (22-423) MANUFACTURING ENGINEERING

I,II(3-0)3

Modern manufacturers processes are studied and compared, included are casting, rolling, extruding, forging, machining, safety, quality control, etc.

22-434 INTRODUCTION TO PROJECT ENGINEERING

I,II(3-0)3

Introduction to contemporary methods for task and project management with orientation to the R&D environment. The lecture and case history study method will be used and together with oral and written presentations by

the student. Emphasis will be placed on planning, programming and budgeting of all resources for process optimization.

22-441, (22-474) ANALYSIS OF THERMO-FLUID SYSTEMS I(3-0)3
Air-standard power and refrigeration cycles. Dimensional analysis; similitude and modeling. Mixtures of ideal gases: airwater vapor mixtures with application to air-conditioning systems. First Law analysis of combustion reactions; adiabatic flame temperature. Compressible flow through a nozzle; Mach number, choking in isentropic flow, normal shock. Prerequisites: 22-242 and 22-381.

22-442 FUNDAMENTALS OF REFRIGERATION ENGINEERING I,II(3-0)3
Thermodynamic cycles of refrigeration machines and heat pumps. Types of refrigeration compressors. Evaporators, condensers, and other heat transfer equipment. Thermodynamic and thermophysical properties of refrigerants. Thermodynamic behavior of mixtures (oil-Freon). Absorption and vapor-jet refrigeration machines. Special problems of heat pumps design. Principles of automatic control for refrigeration machines and heat pumps. Prerequisites: 22-242 or 22-347, 22-381, 22-344.

22-443 FUNDAMENTALS OF CRYOGENIC ENGINEERING I,II(3-0)3
Thermodynamic principles and analysis of cryogenic cycles. Air liquefaction and gas-mixtures separation cycles. Absorption and rectification (distillation) processes and their analysis. Rectification columns, expanders, pumps, heat exchangers, compressors, storage vessels. Insulation. Specifics of cryogenic equipment and instrumentation design. Superconductivity. Separation of inert gases (helium, argon, etc). Safety considerations. Prerequisites: 22-242, 22-344, 22-381. Corequisite: 22-441.

22-448, (22-488) ENVIRONMENTAL CONDITIONING I,II(3-0)3
The control of thermal environment within enclosed spaces including transfer of heat and work energy. Refrigeration cycles, heating humidification, dehumidification and mixtures. Design of conditioned spaces. Prerequisite: 22-242 or 22-347.

22-452, (22-462) ENGINEERING SYSTEMS ANALYSIS I,II(3-0)3
A study of the methods used in engineering analysis with emphasis on the basic types of underlying mathematics. Successful engineering models of equilibrium, eigenvalue, and propagation problems are developed in matrix form, and applied to contemporary problems of an interdisciplinary nature. Prerequisite: Senior status.

22-453, (22-497) AUTOMATIC CONTROL SYSTEMS I(3-0)3
Concept of open loop and feedback control systems. Use of block diagrams and transfer functions for system representation. Transient and steady-state response using frequency and root locus techniques. Stability and compensation. Consideration of hydraulic pneumatic, electromechanical and thermal control systems. Prerequisite: 22-354.

22-454, (22-428) KINEMATIC MECHANISM SYNTHESIS I,II(3-0)3
Methods of designing mechanisms to convert given input motions to required output motions. Topics include function generation- coupler curves- position coordination- and spatial mechanisms. Problems are designed for solution by graphical methods- by computer solution using the analog and digital computers.

22-456, (22-472) EXPERIMENTAL STRESS ANALYSIS I,II(3-0)3
The determination of stresses and strains in loaded members by experimental techniques including photoelasticity, birefringent coatings, holography, Moire methods, brittle coatings, analogies, strain gages. Prerequisite: 22-212.

22-462, (22-452) NUMERICAL ANALYSIS I,II(3-0)3
Iterative solution of algebraic equations, convergence, error estimate, order of iteration, accelerating convergence. Interpolation, difference, error estimates. Numerical differentiation, extrapolation to the limit. Numerical integration, Newton-Cotes formulas, error estimate Romberg integration. Second-order partial differential equations, finite difference representation, error, parabolic equations, accuracy, stability. First order, ordinary differential equations, predictor/corrector methods, Adams-Bashford methods, higher order equations. Student determines course grade by developing computer solutions to problems in fluid mechanics, dynamics and heat transfer using numerical techniques studied in course. Prerequisites: 92-232 or 92-234, 92-263.

22-463 FUNDAMENTALS OF ENGINEERING MEASUREMENTS, INSTRUMENTATION, AND QUALITY CONTROL I,II(3-0)3
Basic review of probability and mathematical statistics. Evaluation of measurement errors. Concept of units and

dimensions. Technical characteristics of measuring instruments. Static and dynamic properties of control instruments. Basic principles of, and requirements for selection of instruments and devices for measurement and control purposes. Evaluation of proper settings and allowable tolerances. Sampling, reliability, and some basics of industrial quality control. Prerequisite: 92-301.

22-481 FLUID MECHANICS II

I,II(3-0)3

Continuation of 22-381. Introduction to the use of the digital computer for solving fluid mechanics problems. Laminar, viscous flows; hydrodynamic lubrication, Navier-Stokes equations. Introduction to turbulence; Reynolds stresses, eddy viscosity, Prandtl's mixing-length theory. Open-channel flow; hydraulic jump, uniform and non-uniform flow. Prerequisite: 22-381.

22-482 TWO-PHASE FLOW

I,II(3-0)3

Introduction to one-dimensional two-phase flow mechanics. Derivation of time and space average equations for two-phase systems. Discussion of special models including the homogeneous model, the separated flow model and the drift flux model. Pressure drop calculations. Waves in two-phase media. Applications include gas-particle systems, gas-liquid systems with different flow patterns, nuclear reactor safety technology, and critical two-phase flows. Prerequisite: 22-344 and 22-381, Senior or graduate standing.

22-483 AERODYNAMICS

I,II(3-0)3

Fundamentals of subsonic aerodynamics. Atmosphere models. Air speed measurement, boundary layers, aerodynamic heating. Circulation, downwash, and three-dimensional wing theory. Airfoil data, and lift and drag of aircraft components. Power required and power available. Introduction to aircraft performance calculations. Prerequisite: 22-381.

22-484 JET PROPULSION AND TURBOMACHINERY

I,II(3-0)3

Air breathing jet propulsion. Thrust, propulsion efficiency. Thermodynamics of Brayton cycle, component efficiencies, thermal efficiency. Comparison of propjets, turbojets, and turbofans. Detailed performance calculation of turbofan engine using measured data and high temperature gas properties. Turbomachinery, velocity triangles, Euler's turbomachinery equation. Axial flow compressor, rotating stall and surge stability compressor map. Axial flow turbines. Exhaust nozzles. After burners. Engine component matching. Future trends in jet propulsion. Prerequisites: 22-242, 22-381, 22-487 or 22-441.

22-485 MECHANICAL ENGINEERING PROBLEMS IN OCEANOGRAPHY

I,II(3-0)3

Fluid mechanics of ocean waves. Tidal waves, surface waves, wind driven waves, Sea State classification of waves. Review of hydrostatics. Fluid mass of accelerating bodies. Stability and motion of ocean platforms and buoys. Forces on submerged mooring cables, cable configurations. Dynamics of liquid spills on water. Prerequisites: 22-381, 22-313.

22-486, (22-429) FLUID POWER CONTROLS

I,II(2-2)3

This subject involves the designing of hydraulic and pneumatic systems from load analysis and performance specifications. Elements of fluid power systems; actuators, valves, pumps and compressors, and accessories, Boolean algebra, pneumatic, electronic and fluid logic systems and electrical relay solenoid controls.

22-487, (22-413) GAS DYNAMICS

I,II(3-0)3

Extension of basic thermodynamic and fluid mechanical equations of motion to inviscid, compressible flows. One-dimensional, steady flows with area change. Fanno and Rayleigh flows. Normal and oblique shocks. Prandtl-Meyer expansion. Prerequisites: 22-242, 22-381.

22-493, (22-419) NONDESTRUCTIVE EVALUATION TECHNIQUES

I,II(3-0)3

The nondestructive evaluation of materials and processes by penetrating radiations, such as sonic, magnetic, thermal, and electrical, and the abilities and limitation of each. Particular emphasis is placed upon the analysis and correlation of the interactions of these energy forms with material properties and processes. Flaw detection; process improvement, control, and monitoring; and measurement of mechanical, physical, chemical and metallurgical properties. Prerequisite: Senior status.

22-495, (22-475) PHYSICAL METALLURGY

I,II(3-0)3

A study of the theories discussed in material science as they apply specifically to mechanical deformation of materials: yielding, creep, fracture, viscoelastic and plastic deformation, etc. The effects of thermal and mechanical treatments on the above properties are also considered in detail. Prerequisite: 22-295.

22-497, (22-477) COMPOSITE MATERIALS**1,II(3-0)3**

This course is a study of composites as engineering materials. The effects of constituent materials on the strengths and stiffnesses of unidirectional, short-fiber, and laminated composites are analyzed in detail. Computer supported analytical techniques for predicting properties of laminates are performed by students. Important processes of composite fabrication and mechanical test methodologies are discussed and the latest research on composite materials is surveyed. Prerequisites: 22-212, 22-295.

Primarily for Graduate Students**22-511, (22-582) MATRIX METHOD IN ENGINEERING MECHANICS****1,II(3-0)3**

Development of matrix methods of analysis as applied to engineering mechanics. Methods include determining eigenvalues and eigenvectors using direct and iterative techniques; solution of large sets of algebraic equations using direct reduction techniques such as CROUT, CHOLESKY and GAUSS-DOOLITTLE schemes; FORTRAN programs involving the methods will be written for the digital computer; problems in mechanical vibrations and stability will involve development of mass and stiffness matrices for structural systems. Problems will be solved using the MATRIX computer program.

22-512, (22-564) STRUCTURAL DYNAMICS**1,II(3-0)3**

Review of matrix operations, development of the equations of motion of a single and multi-degree of freedom systems. Development of stiffness, mass and damping matrices. Condensation of equations by stiffness condensation and GUYAN reduction. Modal analysis techniques to decouple the equations of motion. Direct integration of the motion equations. Discussion of proportional and of the motion equations. Discussion of proportional and non-proportional damping. Applications using computer programs such as MATRIX, FEAP, AND SAP IV to solve problems in structural dynamics.

22-513, (22-562) ADVANCED DYNAMICS**1,II(3-0)3**

Dynamics of mechanical systems by use of direct and variational methods. Three-dimensional rigid body dynamics and vibrations of lumped parameter and continuous systems. Non-linear and self-excited oscillations. Stability.

22-515, 22-516 STRUCTURAL MODAL ANALYSIS**1,II(3-1)3, (3-1)3**

Modelling of structural systems using both analytical and experimental techniques. Analytical technique topics to include: Finite element analysis, synthesis and structural modification of single and multi-degree of freedom systems using computer software, complex modes systems with non-proportional damping and structural simulation using component mode synthesis. Experimental techniques to include digital signal processing fundamentals, fast Fourier transform, autoregression, comparative study of excitation types, coherence function analysis instruments, input loading effects, optimum transducer placement and statistical confidence considerations. Laboratory work will involve actual testing of structures using FFT based modal analysis instruments.

22-518, (22-558) PLATES AND SHELLS**1,II(3-0)3**

Variational methods are utilized to derive the plate and shell equilibrium equations including nonlinear effects and inertia terms. Solutions to bending, buckling and vibration problems are obtained for rectangular and circular plates. The membrane theory of shells as well as the general theory is investigated and solutions are obtained for a variety of practical shell problems.

22-542, (22-531) ADVANCED THERMODYNAMICS**1,II(3-0)3**

A comprehensive treatment of the classical first and second law. Availability, criteria of equilibrium, heterogeneous systems, mixtures and solutions, chemical equilibrium. Introduction to statistical methods as applied to evaluation of thermodynamic properties.

22-543, (22-534) TRANSPORT PROCESS**1,II(3-0)3**

Diffusive and convective transport of mass, momentum and energy. Forced convection in laminar and turbulent flows. Heat and mass transfer accompanied by change of phase and chemical reactions.

22-544, (22-535) ADVANCED HEAT TRANSFER**1,II(3-0)3**

Heat conduction: analytical and numerical solutions. Similarity analysis of laminar forced convection. Tube flows: Graetz solution, thermal entry and fully developed flows: Laws of thermal radiation. Radiative heat transfer in non-absorbing medium.

- 22-545, (22-536) **COMBUSTION** I,II(3-0)3
Dynamics of premixed and diffusion flames: ignition and extinction, burning of liquid and solid fuels, radiation from flames, fire problems.
- 22-546 **ENERGY CONVERSION** I,II(3-0)3
Concepts of thermodynamics pertaining to energy conversion; irreversible thermodynamics. Solid-state phenomena involved in conversion processes; energy forms, equations of states and energy fields. Selected topics in direct energy conversion systems.
- 22-553, (22-566) **RANDOM VIBRATION** I,II(3-0)3
Random processes: probability, time ensemble averages, correlation and power spectra. Stationary and random vector excitation of single and multi degree-of-freedom dynamic systems. Use of computer program RAND to study statistically coupled base and pressure excitations of continuous structures.
- 22-544, (22-572) **DYNAMIC SYSTEMS AND CONTROL** I,II(3-0)3
Classical and modern approaches to the dynamics of systems with multiple inputs and outputs. State equations for hydraulic, pneumatic, electro-mechanical, and thermal systems using the state function of Lagrange. Analytical approach to system response in physical and modal domains. Introduction to simulation and to digital control.
- 22-562, (22-551) **CONTINUUM MECHANICS** II(3-0)3
Cartesian tensors, static and kinematic of a continuum in tensor notation. Fundamental laws of mechanics and thermodynamics. Application to viscous, elastic and viscoelastic continua.
- 22-563, (22-553) **FINITE ELEMENT ANALYSIS** II(3-0)3
A review of matrix algebra and calculus to develop the finite element equations in structural and thermal systems. Review of stress, strain and constitutive equations of solids. Develop mass and stiffness matrices for truss, frames 2D and 3D solids. A large finite element computer program (SAP IV) will be used to solve problems in structural mechanics. Nonsteady heat conduction problems will also be studied using finite element techniques with MATRIX and FEAP programs.
- 22-565, (22-581) **ENGINEERING ANALYSIS** II(3-0)3
A study of the methods used in engineering with emphasis dependent upon the instructor. Topics include matrix methods, variational methods, finite differences, orthogonal series, and the Ritz and Galerkin methods for solving differential equations. Problems include systems encountered in solid mechanics, heat transfer and fluid mechanics.
- 22-566, (22-556) **THEORY OF THE INELASTIC CONTINUUM** I,II(3-0)3
Development of the constitutive equations governing inelastic (anelastic viscoelastic, plastic and viscoplastic) deformations. Theorems and boundary value problems as applied to inelastic continua. Prerequisite: 22-562.
- 22-568, (22-554) **THEORY OF ELASTICITY** I,II(3-0)3
Formulation of the problem of elastic equilibrium. Torsion and flexure of prismatic bars, contact stresses, plane stress, plain strain and stress concentration. Preequisite: 22-562.
- 22-581, (22-541) **ADVANCED FLUID MECHANICS** I,II(3-0)3
Review of fundamental equations of fluid motion, kinematics, vorticity, circulation, Crocco's theorem, Helmholtz's vorticity laws, secondary flows. Stream function, velocity potential, potential flows. Unsteady Bernoulli equation, gravity water waves.
- 22-582 **VISCOUS FLOW** I,II(3-0)3
Review of Navier-Stokes equations. Examples of exact solutions. Boundary-layer approximation. Similarity analysis of boundary layer flows. Introduction of computational fluid dynamics. Compressibility effect: Stewartson transformation. Stability of boundary layer and introduction to turbulence.
- 22-583, (22-548) **ADVANCED TOPICS IN AERODYNAMICS** I,II(3-0)3
Application of aerodynamic principles to one or two of the following topics: aircraft performance analysis, stability and control, orbital mechanics, or helicopter rotor aerodynamics (including propellers and wind turbines). Topics vary from year to year depending on, current departmental research interests. Prerequisite: 22-483.

- 22-587, (22-542) **ADVANCED GAS DYNAMICS** 1,II(3-0)3
Equations of motions for inviscid, compressible fluid. One-dimensional steady flow with area change, friction, heat transfer and combustion. Shock waves. Unsteady flows and wave phenomena. Similarity characteristics, small disturbances, approximation procedures.
- 22-591, (22-521) **MECHANICAL BEHAVIOR OF MATERIALS** I,II(3-0)3
An examination of deformation mechanisms in solids and the study of such topics as brittle and ductile modes of fracture fatigue, creep, viscoelasticity, diffusion, friction and wear using actual case studies of failures. Prerequisite: 22-295.
- 22-592, (22-530) **ULTRASOUND, A NONDESTRUCTIVE EVALUATION** I,II(3-0)3
Propagation characteristics of ultrasound are developed and analyzed to indicate usefulness as a nondestructive method of evaluation. Equipment for generation, detection and display are presented. Scientific and engineering applications using velocity and attenuation measurements are stressed.
- 22-597, (22-552) **STRUCTURAL APPLICATION OF COMPOSITE MATERIALS** I,II(3-0)3
Study of constitutive relationships for anisotropic materials and application of these materials to structural elements such as beams, plates and shells. Problem areas considered include bending, buckling and vibrations. Prerequisite: 22-497 or Permission of instructor.
- 22-601, (22-651) **SELECTED TOPICS IN MECHANICAL ENGINEERING** (3-3) (3-0)6
Advanced topics in the various fields of mechanical engineering. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge of contemporary mechanical engineering.
- 22-701 **THESIS RESEARCH IN MECHANICAL ENGINEERING** (0-9) (0-9)6
Introduction to the methods of contemporary mechanical engineering research. Open only to students who are concurrently engaged in thesis or project research. Prerequisite: Permission of advisor.
- 22-702, (22-751) **ADVANCED PROJECTS IN MECHANICAL ENGINEERING** (0-3) (0-3)2
Independent reading and investigation of a particular topic of current interest in mechanical engineering. Prerequisite: Permission of department.

Nuclear Engineering (Course Prefix: 24)

- 24-204 **SEMINAR IN ALTERNATIVE ENERGY SYSTEMS** II(1-0)1
Overview of the feasibility environmental impact and economics of various energy producing systems.
- 24-206 **THE NUCLEAR POWER SITUATION** II(2-2)3
A descriptive course for non-science and non-engineering majors who want to understand how nuclear reactors work. The underlying principles of reactors are discussed and comparisons are made with other energy systems in terms of benefits and risks, advantages and disadvantages. Federal licensing requirements are discussed and a practical study of the University of Lowell Reactor is included. A previous course in algebra is desired but not required.
- 24-242 **THERMODYNAMICS** I(3-0)3
A detailed development of the First and Second Law of Thermodynamics and applied to systems and changes of state. Thermodynamic properties of pure substances, condensable vapors and the perfect gas. The concept of entropy, reversibility and irreversibility. Steady and unsteady cases.
- 24-301 **FUNDAMENTAL REACTOR PHYSICS** II(3-0)3
Review of relevant nuclear physics binding energy. Q-equation, kinematics, radioactive decay and neutron cross-sections. Slowing down theory. Steady state diffusion theory, criticality of an unreflected reactor. Prerequisite: 80-202, 92-234.
- 24-302 **FUNDAMENTAL REACTOR PHYSICS II** II(3-0)3
Reactor kinetics feedback, fission product poisoning and reactivity coefficient; control rod theory; reflected and heterogeneous reactors; slowing down theory; resonance escape probability; multi-group diffusion theory. Prerequisites: 24-301, 92-301.

- 24-321 INTRODUCTION TO SOLAR ENERGY** I(3-0)3
Energy sources. Introduction to solar energy utilization: overview. Solar radiation in space and at earth's surface: measurements and estimation. Radiation from opaque materials. Partial transmission. Elements of heat transfer. Flat plate collectors. Prerequisite: Junior standing or permission of instructor.
- 24-344 HEAT TRANSFER** I(3-0)3
Theory and application of steady state and transient heat conduction in solids; convective and radiation heat transfer black body radiation; forced and natural convection heat exchangers. Prerequisites: 24-242 and 24-332.
- 24-401 POWER PLANT ENGINEERING I** I(3-0)3
Review of current and projected types of power plants for electric generation, energy production and heat removal; heat transfer in fuel elements and shields; thermo-hydraulics of non-boiling and boiling liquids. Particular emphasis is placed on pressurized and boiling water reactors.
- 24-402 POWER PLANT ENGINEERING II** II(3-0)3
Continuation of 24-401. Review of First and Second Laws of Thermodynamics; analysis of cycles for power production including Rankine and Brayton cycles; heat exchanger design; analysis of components; turbines, pumps, condensers, steam generators, and feed-water-heaters; elements of power economics, evaluation of cost of electricity.
- 24-403 REACTOR OPERATION AND LICENSING** I(2-2)3
Start-up and operation of nuclear plants; regulations, procedures and measurements. Staffing requirements. The licensing process, objectives and criteria, including the roles of the USNRC, the licensee, and the public; review of safety analysis reports and environmental impact statements, technical specifications, and codes. Each student goes through a precritical reactor checkout, critical approach, and various reactor operational measurements in the University of Lowell reactor. Prerequisite: Permission of instructor.
- 24-404 POWER SYSTEMS DESIGN** II(3-0)3
A group design project in which the class participates in the overall design of power plant systems, integrating the requirements of physics, control heat transfer, thermodynamics, fuel cycle, economics, safety, siting and radiological and environmental effects. Each member of the class will be responsible for a particular aspect of the design. Prerequisites: 24-301, 24-401.
- 24-410 NUCLEAR ENGINEERING MATERIALS I** I(3-0)3
Fundamentals of material science crystal structure. Bravais lattices, crystal planes and directions: types of bonding, disorder, solid solutions, solid state diffusion, elastic and plastic behavior; phase equilibrium; utilization of materials; processing, mechanical failure, corrosion; applications of nuclear engineering, including fundamentals of radiation damage and effects. Prerequisite: Permission of instructor.
- 24-411 NUCLEAR ENGINEERING MATERIALS II** I(3-0)3
Radiation damage; effects on components in nuclear systems; embrittlement creep, resistivity; design applications to fission and fusion systems; nuclear fuels, types, design, characteristics, fabrication techniques. Prerequisite: Permission of instructor.
- 24-415 INTRODUCTION TO FUSION RESEARCH** I,II(3-0)3
Fusion reactions, the Coulomb Barrier. Phase space moments of the distribution function; change, current density and pressure tensor. The Saha Equation. The Maxwell Equations. Elementary Plasma Theory. Possible approach to controlled fusion; methods of plasma confinement. Energy balance equations for a plasma, radiation losses, operational conditions, and utilization of thermonuclear neutrons. A design project is included. Prerequisite: Senior standing or permission of instructor.
- 24-419 REACTOR OPERATOR TRAINING** I(0-6)3
Training, including in-reactor experience and topical lectures, as given to Reactor Operators Trainees who will undergo Federal testing for a Reactor Operator License.
- 24-420 REACTOR OPERATOR TRAINING** II(0-6)3
Continuation of 24-419. Upon completion of this course, the student will be given a simulated Reactor Operator Examination, including a written test, an oral test about reactor systems and a controls manipulation test, much like the Federal examination.

- 24-424 **SOLAR ENERGY** II(3-0)3
 Solar intensity and solar flux. Measurements and attenuation of solar radiation in the atmosphere. Tracking collectors. Concentrators. Central solar receivers. Heating and cooling. Industrial process applications. Prerequisite: 24-321.
- 24-427 **SOLAR ARCHITECTURE** I(3-0)3
 Historical survey of solar concerns in architecture. Design with climate; modern technologies. Course includes a student design project. Prerequisite: 24-424.
- 24-495 **SPECIAL NUCLEAR PROBLEMS** I(3-0)3
 Special problems in nuclear engineering assigned to the individual student, with emphasis on modern research methods and preparation of results for publication. Prerequisite: Permission of department chairperson, and instructor.
- 24-496 **SPECIAL NUCLEAR PROBLEMS** II(3-0)3
 Continuation of 24-495 for a second semester. Prerequisite: Permission of department chairperson and instructor.

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of instructor.

- 24-501, 24-502 **GRADUATE RESEARCH SEMINAR** I,II(1-0)1
 Presentation and discussion by faculty members, invited speakers, and qualified graduate students of recent developments in the field of nuclear, solar and geothermal engineering energy policy and the financial and social cost of power. Required for all graduate students. Weekly meetings.
- 24-505 **REACTOR THEORY AND ANALYSIS I** I(3-0)3
 Review of nuclear physics, nuclear reactions, cross-sections, and the fission reaction. Development of the general time dependent equation for neutron diffusion in physical and energy space. Exploration of analytical and numerical solutions of this equation starting with simplified social cases which approximate some aspects of nuclear reactor behavior. The approximations are systematically removed to end with the state of the art treatment of nuclear reactor analysis in full space depending detail in two energy groups. Prerequisite: Permission of instructor.
- 24-506 **REACTOR THEORY AND ANALYSIS II** II(3-0)3
 Continuing from 24-505 with development of the full space energy analysis of nuclear reactors. Application of these techniques to the fuel consumption problem, the reactor control problem and the methods of analysis based upon perturbation theory. Finally, the Boltzman equation or the general space, energy, time equation for transport of neutrons is introduced. Elementary solution methods are explored and a reduction is made to diffusion theory showing the level of approximations inherent in diffusion analysis. Prerequisite: Permission of instructor.
- 24-507 **POWER PLANT ENGINEERING I** I(3-0)3
 Review of current and projected types of power plants for electric generation; energy production and heat removal, heat transfer in fuel elements and shields; thermo-hydraulics of non-boiling and boiling liquids. Particular emphasis is placed on pressurized and boiling water reactors.
- 24-508 **POWER PLANT ENGINEERING II** II(3-0)3
 Continuation of 24-401. Review of First and Second Laws of Thermodynamics of cycles for power production including Rankine and Brayton Cycles; heat exchanger design; analysis of cycle components, turbines, pumps, condensers, steam generators, and feed-water-heaters; elements of power economics evaluation of cost of electricity.
- 24-509 **FAST REACTORS** I(3-0)3
 General characteristics of fast reactors. Breeding cycles and plutonium production; neutron balance, breeding ratio and doubling time. Simplified methods for fast reactor calculation. Kinetic control and safety of fast reactors; sodium void and Doppler coefficients. Engineering consideration of design concepts in large. Prerequisite: 24-302 or 24-506.

- 24-510 NUCLEAR FUEL CYCLE AND POWER ECONOMICS** II(3-0)3
Discussion of the nuclear fuel cycle, including pre-irradiation, irradiation, and post-irradiation steps encountered by the fuel in a nuclear reactor. Evaluation of the components of the cost of electricity produced by a nuclear reactor. Prerequisite: 24-302 or 24-306.
- 24-512 CRITICALITY AND NUCLEAR REACTOR SAFETY** II(3-0)
Consideration of safe practices in transportation, storage, handling, and use of fissionable materials. Effects of moderators, reflectors, and geometrics in thermal, epi-thermal, and fast assemblies. Natural and engineered safeguards are discussed. Prerequisite: Permission of instructor.
- 24-514 NUCLEAR WASTE DISPOSAL** II(3-0)3
The course is an introduction to the engineering design of disposal systems. The history of nuclear waste disposal is examined, the status of generated wastes is reviewed, and the character and quantities of future wastes are studied. A review of all advanced disposal concepts and appropriate design methods is made on a generic rather than specific basis. The now unfolding national plan for waste disposal is studied and its design critically evaluated. The analytical methods in waste disposal span many branches of Engineering science and are only introduced as to underlying physical basis. That is, the extensive details of chemical engineering methods, heat transfer, material properties, and geology are avoided in the coverage of the waste disposal methods. Knowledge of basic methods in these areas is assumed. Prerequisite: Senior standing and permission of instructor.
- 24-515 CONTROLLED THERMONUCLEAR FUSION I** I(3-0)3
Introduction to plasma physics. Particle orbit theory and adiabatic invariants. The kinetic equation. Macroscopic description criteria for the applicability of the fluid model. Kinematics, and static problems. Macroscopic instabilities. Hydromagnetic flows, the Navier-Stokes equation. Waves and shocks. plasma radiation. Kinetic Theory. Near-equilibrium plasmas. The Vlasor equation and Landau damping. Microscopic instabilities. Transport coefficients. Prerequisite: 416 or permission of instructor.
- 24-516 CONTROLLED THERMONUCLEAR FUSION II** II(3-0)3
Introduction: major approaches to controlled fusion. Fuel cycles. Plasma sources and diagnostics. Confinement. Energy balances in fusion reactors, reactor performances, and the generalized Lawson criterion. The conversion of fusion energy direct collection, electromagnetic coupling and thermal conversion. Fusion neutronics. Prerequisite: 24-416 or permission of instructor.
- 24-519 REACTOR OPERATOR TRAINING** I(0-6)3
Training, including in-reactor experience and topical lectures, as given to Reactor Operator Trainees who will undergo Federal testing for a Reactor Operator License.
- 24-520 REACTOR OPERATOR TRAINING** I(0-6)3
Continuation of 24-519. Upon completion of this course, the student will be given a simulated Reactor Operator examination, including a written test, an oral test about reactor systems, and a controls manipulation test, much like the Federal examination.
- 24-521 INTRODUCTION TO SOLAR ENERGY** I(3-0)3
Energy sources. Introduction to solar energy utilization; overview. Solar radiation in space and at earth's surface; measurements and estimation. Radiation from opaque materials. Partial transmission. Elements of heat transfer. Flat plate collectors. A project and paper are required. Prerequisite: Permission of instructor.
- 24-524 SOLAR ENERGY** II(3-0)3
Solar intensity and solar flux. Measurements and attenuation of solar radiation in the atmosphere. Tracking concentrators. Central solar receivers. Heating and cooling. Individual process applications. A project and paper are required. Prerequisite: Permission of instructor.
- 20-105 NUMERICAL METHODS OF ENGINEERING ANALYSIS** I(3-0)3
Finite dimensional vector spaces, matrix algebra, finite difference equations and matrix iterative techniques. Applications involving the neutron diffusion and heat conduction equations. Description of the Monte Carlo and response matrix methods. Prerequisite: Permission of instructor.
- 24-526 ADVANCED ENGINEERING ANALYSIS** II(3-0)3
Adjoint Monte Carlo calculations, the method of Greens functions, eigenfunction solutions of differential equations, variational techniques and perturbation theory. Description of the S^N method for solving the particle transport equation. Prerequisite: 24-525 or permission of instructor.

24-528 ADVANCED SOLAR ENERGY

II(3-0)3

Energy storage and solar air conditioning. Computer modeling of solar energy systems. Elements of solid state physics. The photovoltaic generation of electricity. Solar energy economics. Central solar receivers.

24-529 GEOTHERMAL AND WIND ENERGY

I(3-0)3

Most of the time will be allocated to a systematic study of Geothermal energy resources types, their distribution throughout the United States, and the methods whereby they can be made to contribute to our energy resources. Some time will be allocated in a complementary vein to the economics of wind machines at the same time geothermal economics is considered. The economics will complement data from solar, fission, and fusion courses. One type geothermal plant will be studied from exploration through operation, testing in an engineering, design approach. Prerequisite: Senior standing or permission of instructor.

DEPARTMENT OF PLASTICS ENGINEERING

Chairperson: Nick Schott

Professors: Aldo Crugnola, Rudolph Deanin, Raymond Normandin, Clarence Pope, Nick Schott, Amad Tayebi

Associate Professors: Everett Arnold, S.J. Chen, Stephen Burke Driscoll, Stephen Orroth, Jr.,

Assistant Professor: Stephen Petrie

Plastics Engineering is a specialized body of knowledge concerned with the synthesis of polymeric materials and their conversion to useful end products. It is the practical application of principles of mathematics, physics, chemistry, engineering and economics to the field of high polymers.

Plastics Engineering Program

This program is designed to prepare the graduate for a professional career in the polymer industries (of which plastics is the largest), man made fibers, rubber, coating, and adhesives. The curriculum, provides a sound basis in mathematics, chemistry, process engineering, plus a full study of plastic materials, properties, process engineering, and product design. It includes sufficient flexibility for further specialization in areas of individual interest. Undergraduates also have the privilege of joining the first student chapter of the International Society of Plastics Engineers. (ISPE)

Since the program started in 1954, more than 800 graduates have been employed by polymer industries throughout the United States, Europe, and Asia. Major plastics producers and users recruit annually on campus. While most job openings are in product and process development or in technical service and marketing, some graduates also go into research, manufacturing, consulting, and teaching. This curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET).

COURSE OF STUDY FOR PLASTICS ENGINEERING#

Freshman Year

Fall Semester

00-101 Perspectives in Eng.

* 84-121 Chemistry

* 84-123 Chemistry Laboratory

42-101 College Writing

92-131 Calculus B-I or

92-133 Calculus A-I

+ 95-141 Physics

+ 96-141 Fund. of Exp. Phys. I
Physical Ed.

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Spring Semester

* 84-126 Chemistry

* 84-124 Chemistry Laboratory

42-102 College Writing and Literature

92-132 Calculus B-II or

92-134 Calculus A-II

+ 95-144 Physics II

+ 96-144 Fund. of Exp. Phys. II
Physical Ed.

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* 84-135 Honors Chem. and, 84-137 Honors Chem. Lab.

+ 95-147 Honors Physics and 96-147 Fund.
Exp. Phys. I may be substituted.

* 84-136 Honors Chem. & 84-138 Honors Chem. Lab.

+ 95-148 Honors Physics and 96-148 Fund.
Exp. Phys. II may be substituted

Sophomore Year

Fall Semester

84-223 Organic Chemistry-B

84-225 Organic Chem. I-B Lab.

92-231 Calculus B-III or

92-233 Calculus A-III

92-261 Digital Computer Prog.

22-215 Analytic Mechanics I

22-201 Polymeric Materials I

26-215 Plastics Process. Lab. I

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Spring Semester

84-224 Organic Chem. II-B

84-226 Organic Chem. II-B Lab.

92-234 Differential Equations

22-216 Analytic Mechanics II

26-202 Polymeric Materials II

26-214 Fluid Flow & Rheology of Polymers

26-216 Plast. Process. Lab. II

26-272 Intro. Plast. Tool. Opn

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Junior Year					
Fall Semester			Spring Semester		
26-347	Ele. of Thermodynamics	3	84-339	Physl. Chem. Principles	3
26-395	Materials Science	2	84-341	Physl. Chem. Prin. Lab.	1
64-201	Economics I	3	26-316	Plast. Process. Lab. IV	1
26-301	Polymeric Materials III	3	16-350	Intro. Elec. Power/Mach.	3
26-315	Plast. Process. Lab III	1	26-304	Process Control Sys.	3
26-373	Plast. Mold Eng. I	3	26-348	Heat Transfer	3
	Area I Elective	3	*	ROTC or Tech Elective	3
		18			17
Senior Year					
Fall Semester			Spring Semester		
85-403	Intro. Phys. Chem. of Macromolecules	3	84-404	Intro. Org. Chem. of Macromolecules	3
84-405	Polymer Lab. I	1	84-406	Polymer Lab. II	1
26-401	Plast. Process. Eng. I	3	26-402	Plast. Process. Eng. II	3
26-403	Phys. Properties of Polymers	3	26-406	Polymer Structure	3
26-415	Physl. Properties Lab. I	1	26-416	Phys. Propert. Lab. II	1
26-411	Plastics Seminar	1	26-412	Plastics Seminar	1
	ROTC or Tech Elective	3		Area I or II Elective	3
	Area I or II Elective	3		Area I or II Elective	3
		18			18

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Technical electives must be junior level courses in engineering or science.

Combined B.S./M.S. Degree Program In Plastics

The Plastics Engineering Department offers a program of accelerated study in order to encourage outstanding undergraduate students to continue their studies toward an advanced degree in plastics and other polymer applications. To be eligible to enter this course of study, the student must file a formal Graduate School application in the junior year. This does not require the student to take GRE or Advanced GRE examination.

Upon recommendation of the student's advisor, and with the approval of the departmental graduate admissions committee and the dean of the Graduate School, the student may be admitted to graduate study during the senior year. Then, upon the recommendation of the Graduate School dean, the student officially becomes a provisional graduate student in the second semester of the senior year.

The student will then receive a bachelor's degree at the end of the fourth year of study, if all course requirements have been met, and may then be recommended for status as a fully-matriculated student upon recommendation of the departmental admissions committee and approval of the dean of the Graduate School before the start of the fifth year.

Graduate or advanced undergraduate (400 level) courses taken during the senior (or Junior) year may be used for both the graduate and undergraduate degrees up to a total of 8 credits.

Normally the eight senior credits would come from the following sequence:

Fall Semester		
26-411	Senior Seminar:	Take 26-601 Graduate Seminar instead.
	Undesignated Elective:	Take Graduate Plastics elective.
Spring Semester		
26-412	Senior Seminar:	Take 26-602 Graduate Seminar instead.
	Undesignated Elective:	Take Graduate Plastics elective.

During the summer preceding the fifth year the student may start his/her thesis research. The student can then complete 16 credits of electives and 6 credits of research during the fifth year and use the following summer to complete thesis work if necessary.

In addition, undergraduate with a light course load or an approved overload may take further graduate courses, not required toward the B.S. degree, for future credit toward the M.S. degree.

The student must meet all departmental and Graduate School regulations for the M.S. degree.

Students taking full advantage of the combined program ordinarily would be expected to finish the M.S. degree at the end of the fifth year of study. However, this will depend upon the student's course load and thesis work.

The student may be eligible for financial assistance, i.e. fellowships and teaching assistantships, during the fifth year of study but this may delay completion of the program.

Plastics Engineering (Course Prefix: 26)

26-201 POLYMERIC MATERIALS I

I(3-0)3

An intensive study of the many generic classes of polymeric materials: review of important raw materials, polymerization theory and practice, methods of manufacture, and correlation of polymer structure with engineering properties. Review of marketing principles and property/performance characteristics.

26-202 POLYMERIC MATERIALS II

II(3-0)3

A continuation of Polymeric Materials I. Emphasis is on the thermoplastic resins and especially the engineering polymeric. Comprehensive review of product performance in its relationship to basic design principles as representative manufacturing systems. Discussion of polyblends with emphasis on related polymer chemistry, inter-and intra-molecular bonding, and fundamental processing characteristics. Outline of recent developments in thermal extreme polymeric systems. Prerequisite: 26-201 or Permission of instructor.

26-211 PLASTICS MATERIAL SCIENCE

II(3-0)3

Discussion of the historical development of polymeric materials, related classification systems, and methods of manufacture. Survey of the more prominent resin families with particular emphasis on the engineering plastics. Review of end-use applications with respect to pricing, processing and performance. (Primarily for Industrial Technology majors).

26-214 FLUID FLOW AND RHEOLOGY OF POLYMERS

II(3-0)3

Statics and dynamics of Newtonian fluids. Flow in closed conduits. Measurement of fluid flow. Flow of suspensions. Rheology of melts.

26-215 PLASTICS PROCESS ENGINEERING LABORATORY

I(0-3)1

A laboratory course to study polymer processing methods. Experiments are designed so that the student will understand the theory of polymer conversion techniques by the interaction between process variables and materials. Some of the conversion methods studies are extrusion, injection molding, blowing molding, thermoforming, compounding and mixing.

26-216 PLASTICS PROCESS ENGINEERING LABORATORY II

II(0-3)1

A continuation of 26-215.

26-272 INTRODUCTION TO PLASTICS TOOLING OPERATIONS

II(0-3)1

The technique of communicating engineering information and concepts by means of orthographic drawings, pictorial views and sketches. Lectures on design, drawings, dimensioning, fasteners, gears, cams, bearings and manufacturing techniques. Lectures, demonstration and laboratory experience in materials processing. Laboratory experiences in sketching, layout and design drawing.

26-301 POLYMERIC MATERIALS III

I(3-0)3

A continuation of 26-201, 26-202 with emphasis on engineering and specialty high performance polymers, etc..

26-303 ADDITIVES FOR POLYMERIC MATERIALS

I(3-0)3

Analytical review of the chemical satellites incorporated in base polymers to modify processing characteristics and inherent/physical properties. Theoretical review of reinforcements, chemical and physical compatibility of additives, plasticizer theory, thermal and oxidative stabilization/degradation mechanisms, flame retardant actions, and other important additives such as colorants, biostats, blowing agents, anti-static treatments and impact modifiers/processing aids. Prerequisites: 26-201, 26-202 or permission of Instructor.

26-304 PROCESS CONTROL SYSTEMS

II(3-0)3

Basic principles of control systems used with plastics processing equipment. Included are instrumentation, signal conditioning, data acquisition, feedback control, process monitoring and data reduction. Prerequisite: 92-234 or permission of Instructor.

26-315 PLASTICS PROCESS ENGINEERING LAB III

I(0-3)1

Laboratory instruction of a more advanced nature in the processing and fabrication of plastics materials. A con-

tinuation of the processing laboratory sequence but with the emphasis on student designed experiments. Prerequisite: 26-216.

26-316 PLASTICS PROCESS ENGINEERING LAB IV II(0-3)1
A continuation of 26-315.

26-347 ELEMENTS OF THERMODYNAMICS I(2-0)3
The principles of thermodynamics, a study of the first and second laws of thermodynamics with applications to classic systems and polymer systems. Thermodynamic properties of polymers. The concepts of entropy, reversibility, irreversibility and availability.

26-348 HEAT TRANSFER II(3-0)3
Theory and application of steady and transient heat condition, convection, and radiation. Heat transfer in plastics processing. Heat transfer and polymeric dissipation in viscous fluids.

26-373 PLASTICS MOLD ENGINEERING I I(2-0)3
Course work entails the introduction to the fundamentals of plastics mold and die engineering with the objective to develop an overall appreciation of the mold engineer's job. Emphasis is placed on the approach to mold engineering to include the interrelationships of polymeric materials, processing, plastics product design: mold and die design/construction, and design communications. Laboratory consists of the actual design of a mold or mold components with emphasis on mechanical drawing in design communications.

26-376 PLASTICS MOLD ENGINEERING II II(2-2)3
A continuation of 26-373 Plastic Mold Engineering I. Emphasis is placed on injection and "prototype" mold design. Laboratory consists of a case study approach to the lecture materials, and the design and construction of prototype molds.

26-395 MATERIALS SCIENCE I(2-0)2
Materials for use in engineering applications are presented in terms of their general mechanical behavior, the thermodynamics of their structures, and their properties as related to their atomic and crystalline structure. The specific differences and similarities between metals, polymers and ceramics are emphasized. Same as 22-395 except that polymeric materials will not be covered.

26-401 PLASTICS PROCESS ENGINEERING I I(3-0)3
A study of the fundamental principles of polymer processing, i.e., the conversion of the polymeric materials into useful articles. Correlation between process variables, material characteristics and part design are studied to determine the functional relationships between them. Prerequisite: 26-315, 26-316.

26-402 PLASTICS PROCESS ENGINEERING II II(3-0)3
A continuation of 26-401. Prerequisite: 26-401.

26-403 PHYSICAL PROPERTIES OF POLYMERS I(3-0)3
Introduction to basic mechanical properties of polymers as linear viscoelastic materials. Concepts of creep, stress relaxation, and superposition principles are emphasized. Dynamic mechanical behavior, interrelations between various properties, electrical behavior, miscellaneous mechanical properties, optical properties. Prerequisite: Senior status.

26-406 POLYMER STRUCTURE II(3-0)3
The fundamental relationships between molecular structure, properties and end-use applications of plastics materials will be explored in detail. Molecular structural features include chemical composition, molecular size and flexibility, intermolecular order and binding, and supermolecular structure. Properties include processability, mechanical, acoustic, thermal, electrical, optical and chemical properties, price, and balance of properties. Applications include rigid solids, flexible solids, foams, film and non-plastics applications.

26-407 PLASTICS INDUSTRY ORGANIZATION I(3-0)3
Economics of producing plastics raw materials and converting them into end products, from research and development to plant construction, operation, and marketing. Market analysis of plastics production, processing, and consumer patterns; commercial development, sales, and technical service. Organization of the plastics industry for research and development, specialty and commodity production, profit and growth. Prerequisite: Permission of instructor.

- 26-409 SENIOR RESEARCH IN PLASTICS** I(1-6)3
Individual research projects in plastics chemistry, properties, processing, products, and industry organization. Students will review the existing literature, obtain materials and equipment, plan and carry out research programs and submit final reports for publication. Prerequisite: Permission of instructor.
- 26-410 SENIOR RESEARCH IN PLASTICS** II(1-6)3
Continuation of 26-409.
- 26-411 PLASTICS SEMINAR I** I(1-0)1
Normal discussions based on literature study conducted by the individual of topics in or related to Plastics Engineering.
- 26-412 PLASTICS SEMINAR II** II(1-0)1
Continuation of 26-411.
- 26-413 SENIOR PROJECTS** II(0-2)1
Continuation of 26-413.
- 26-414 SENIOR PROJECTS** I(0-2)1
Assignment of senior projects designed to develop the student's ability to organize and conduct investigations of materials performance and processing techniques.
- 26-415 PHYSICAL PROPERTIES LABORATORY I** I(0-3)1
Measurement of mechanical properties in tension, compression, shear, and flexure; dielectric constant and dissipation factor; thermal behavior under stress; melt rheology.
- 26-416 PHYSICAL PROPERTIES LABORATORY II** II(0-3)1
Continuation of 26-415.
- 26-417 PLASTICS PROCESSING TECHNIQUES** I(1-2)1
A study of the manufacturing techniques used in the plastics industry. Emphasis will be placed on extrusion, injection molding, blow molding, compounding and thermoforming. Correlation between the properties of a material and its processability will be investigated. Not open to students majoring in Plastics Engineering.
- 26-420 PLASTICS IN ELECTRICAL ENGINEERING** II(3-0)3
Elective course in applied polymer science as related to current potential electrical engineering applications. Attention devoted to polymeric materials and reinforced plastics, principal physical properties, processing methods and manufacturing consideration, and testing methods. Review of practical applications with emphasis on price, processability, and performance.
- 26-421 INDUSTRIAL SEMINAR I** II(1-0)1
A series of topics relating to plastics materials, processes and engineering presented by representatives of the Plastics Industry. Course is intended to utilize the expertise of industry to specific areas of interest.
- 26-422 INDUSTRIAL SEMINAR II** II(1-0)1
Continuation of 26-421.
- 26-431 SURVEY OF MAN MADE FIBERS AND FIBER STRUCTURES** I(3-0)3
Discussion of the basic problems encountered in the man made fiber industries, including fiber and fiber structure properties, processing, utilization and various aspects of current research. Recent advances and projected developments.
- 26-445 METHODS OF EXPERIMENTAL ANALYSIS** I(3-0)3
Methods of efficient design and analysis of scientific and industrial processing experiments. Classical versus factorial experiments, statistical distributions and statistical inference, single and multifactorial analysis, interaction correlation and regression.
- 26-451 SELECTED TOPICS IN PLASTICS** I(3-0)3
Topics in various fields of plastics. Content may vary from year to year so that students may by repeated enrollment acquire a broad knowledge of contemporary plastics.
- 26-452 SELECTED TOPICS IN PLASTICS** II(3-0)3
Continuation of 26-451.

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of instructor.

26-502 NEW PLASTICS PROCESSING TECHNIQUES

II(3-0)3

Critical examination of new plastics processing techniques appearing in the research literature and being commercialized in the plastics industry. Prerequisite: Permission of instructor.

26-503 MECHANICAL BEHAVIOR OF POLYMERS

I(3-0)3

Mechanical properties of bulk polymers as a class of engineering materials. Linear Viscoelasticity and its application to relaxation, creep, dynamic and stress/strain response phenomena. The principles of time/temperature superposition, the relation between the chemical/physical structure of polymers and their utilization as plastics, elastomers, and fibers. The effect of molecular weight distribution, branching, cross-linking, order and crystallinity on bulk properties. Statistical and mechanical formulation of rubber elasticity. Ultimate and/or failure behavior of polymeric materials and their interpretation on the molecular level. Prerequisite: Permission of instructor.

26-504 PROCESSING, MORPHOLOGY, AND PROPERTIES

II(3-0)3

Effect of processing conditions on polymer fine structure and morphology, and the attendant changes in mechanical and physical properties. Theoretical interpretation of the interrelationships involved. Prerequisite: 26-503.

26-509 PLASTICS PROCESSING THEORY I

I(3-0)3

Principles of heat transfer, rheology, mixing, crystallization, and chemical reactions involved in the processing of plastics, and their applications of plastics process engineering. Prerequisite: Permission of instructor.

26-510 PLASTICS PROCESSING THEORY II

II(3-0)3

Continuation of 26-509. Prerequisite: Permission of instructor.

26-511 MULTIPHASE POLYMER SYSTEMS

I(3-0)3

Compatibility of polymer blends, block and graft copolymers. Morphology of semicompatible systems, and theoretical relationships between structure and properties. Practical systems development and production. Prerequisite: Permission of instructor.

26-512 PLASTICS FOAMS

II(3-0)3

Preparation, structure, and properties of plastics foams. Practical systems in development and production. Properties, applications, and markets for plastics foams and products made from them. Prerequisite: Permission of instructor.

26-513 NEW PLASTICS MATERIALS

I(3-0)3

Critical examination of the new plastics materials appearing in the research literature and being field-tested for commercialization in the plastics industry. Prerequisite: Permission of instructor.

26-515 THEORY AND TECHNOLOGY OF FIBER SPINNING

(3-0)3

Principles and theory of rheology, heat and mass transfer associated with the forming operations in melt and solution spinning of fibers. The equations of motion, continuity and energy are used to formulate the analytical description of fiber spinning. Applications of the theory are discussed in terms of equipment and practices of the synthetic fiber industry.

26-516 COMPOSITE MATERIALS

II(3-0)3

The potential of composites as a class of materials, and the uniqueness of the mechanical/physical properties realizable. Fundamental concepts underlying those properties, with particular emphasis on fibrous reinforced plastics. Survey of matrices, reinforcements, and prediction of composite properties from a knowledge of the properties and topology of constituent materials. Factors affecting ultimate strength and fatigue behavior. Prerequisite: Permission of instructor.

26-518 PRODUCT DESIGN

II(3-0)3

Theoretical principles and sound engineering practice involved in the design of new end products made from polymers applying the total systems approach to the balance between product design, choice of materials, and process technique, as they affect competitive choice for commercial success. Prerequisite: Permission of instructor.

- 26-521 POLYMERIZATION ENGINEERING** I(3-0)3
Engineering design of equipment and plants for polymer production. Processes for production of each of the major commercial polymers. Prerequisite: Permission of instructor.
- 26-523 MATERIAL AND ENERGY BALANCES IN PLASTICS PROCESSING** I(3-0)3
Batch and continuous processes. Dimensional analysis. Thermodynamic properties of thermoplastics. The use of enthalpy diagrams in energy balances. Heat capacity, sensible heat, heat of fusion, and heat of reaction. Intensive and extensive properties of plastics. Phase changes and transitions in thermoplastics. Prerequisite: Permission of instructor.
- 26-524 PROCESS ANALYSIS, INSTRUMENTATION AND CONTROL** II(3-0)3
Industrial instruments for measurement and control of plastics processes. Design of experiments. Analysis of plastics forming operations. Dynamic testing techniques. Automatic plastics process control. Modeling and process simulation in extrusion and injection molding. Data acquisition systems. Prerequisite: Permission of instructor.
- 26-525 PHYSICAL AND CHEMICAL PROCESSING OF SYNTHETIC FIBERS AND FIBER STRUCTURES** (2-2)3
An introduction to systems utilized in the processing of synthetic fiber structures. These include drawing, winding, texturing, staple fiber production, blending, static control, dyeing and finishing. The effect of these mechanical, physical, and chemical processes on the resultant fiber and fiber structure behavior.
- 26-526 ADVANCED PHYSICAL AND CHEMICAL PROCESSING OF SYNTHETIC FIBERS AND FIBER STRUCTURES** (3-0)3
A continuation of 26-525 to include a more detailed view of the processes and effects involved.
- 26-527 MECHANICS OF FIBROUS STRUCTURES** I(2-3)3
Characteristics of fibers affecting performance of conventional and non-conventional fibrous structures. Design considerations and mechanical behavior of twisted, knitted, woven, braided and nonwoven fibrous materials. Prerequisite: Permission of instructor.
- 26-528 NON-CONVENTIONAL FIBER STRUCTURES** II(2-3)3
Non-woven materials and unusual fiber structures such as needle-punched, stitch bonded and ultrasonic welded structures. Problems are assigned for laboratory evaluations and written reports as well as oral presentations are required. Prerequisite: Permission of instructor.
- 26-529 FIBER EVALUATION** (2-2)3
Basic mechanical tools, techniques and their utilization by industry for research, development, production control and end use evaluation. Moisture equilibrium and rates of change relations, basic fiber, yarn and structure dimensions; and an introduction to the determination and evaluation of the stress-strain-time properties of fibers and fiber structures; wear and abrasion are among the topics considered.
- 26-530 INTRODUCTION TO FIBER MARKETING, MANAGEMENT AND PLANT ORGANIZATION** (3-0)3
An introduction to basic principles in the marketing, management, and plant organization of synthetic fibers. Consideration of distribution channels, costing, sales forecasting, management recruiting and machinery layouts.
- 26-531 SURVEY OF MAN-MADE FIBERS & FIBER STRUCTURES** I(3-0)3
Discussion of the basic problems encountered in the man-made fiber industries, including fiber and fiber structure properties, processing, utilization and various aspects of current research. Recent advances and projected developments.
- 26-532 ADHESIVES** II(3-0)3
Theories of adhesion. Materials and compounding. Methods of application. Adherends and applications. Prerequisite: Permission of instructor.
- 26-533 COATINGS SCIENCE AND TECHNOLOGY I** I(3-0)3
Polymers, fillers, solvents, and additives used in coatings. Methods of polymerization, formulation, application, and testing. Substrates and applications. Prerequisite: Permission of instructor.

26-534 COATINGS SCIENCE AND TECHNOLOGY II
Continuation of 26-533.

II(3-0)3

26-535 RUBBER

I(3-0)3

Polymerization and compounding of the commercial elastomers. Properties and test methods. Leading applications and methods of processing. Prerequisite: Permission of instructor.

26-536 RHEOLOGY

II(3-0)3

Fundamental principles of the flow of polymers in bulk, melt, solution, and latex form. Flow instabilities associated with viscoelastic flow. Prerequisite: Permission of instructor.

26-537 ENGINEERING PROPERTIES OF PLASTICS

I(3-0)3

Theoretical basis and practical significance of the mechanical, thermal, electrical, optical and chemical properties of plastic materials. Importance of engineering properties in material development and selection and in product design. Prerequisite: Permission of instructor.

26-545 METHODS OF EXPERIMENTAL ANALYSIS

(3-0)3

Methods of efficient design and analysis of scientific and industrial processing experiments. Classical vs. factorial experiments, statistical distributions and statistical inference, single and multifactorial analysis, interaction, correlation and regression.

26-583 RESEARCH METHODOLOGY

(3-0)3

A systemic evaluation of the techniques used in efficient research and development. Experimental data are analyzed and plotted using a mathematical approach. Creative thinking, problem solving, and student presentation of data are stressed. Extensive reading of research papers, analysis of such and defense of the analysis required.

FACULTY OF THE COLLEGE OF ENGINEERING

Dean Of The College Of Engineering: Aldo Crugnola, A.B., M.S., SC.D.

Assistant To The Dean For Academic And External Affairs: William Kyros, B.S., S.M., Ph.D.

Assistant To The Dean For Technology And Continuing Education: J. Robert Lemieux, B.S., M.S.

Assistant To The Dean For Research And Graduate Studies: John A. McElman, B.S., M.S., Ph.D.

Assistant To The Dean For Facilities And Planning: Kenneth L. Rogers, B.S., P.E.

Department Chairpersons:

Frank Alberti, B.S.C.E., M.S.C.E., M.S.M.E., Ph.D., Industrial Technology

F. Ross Holmstrom, B.S., M.S., Ph.D., Electrical Engineering

Zelman Kamien, B.S., M.S., Ph.D., Mechanical and Energy Engineering

Norwood H. Keeney, Jr., B.S., M.S., Ph.D., P.E., Chemical Engineering

Donald Leitch, B.S., M.S., P.E., Civil Engineering

Nick R. Schott, B.S., M.S., Ph.D., Plastics Engineering

Resident Faculty

Alberti, Frank P. Jr., Associate Professor, Industrial Technology: B.S.C.E., Tufts University; M.S.C.E., Worcester Polytechnic Institute; M.S.M.E., Northeastern University; Ph.D., University of New Hampshire.

Apfelbaum, Jack H., Associate Professor, Industrial Technology; B.M.E., City College of New York; M.M.E., University of Connecticut; Ed.M., Harvard University; P.E.

Arnold, Everett S., Associate Professor, Plastics Engineering; B.S., Southeastern Massachusetts University; M.S. Lowell Technological Institute.

Bacchialoni, Francesco L., Associate Professor, Electrical Engineering; Dott. Ing., University of Genova (Italy).

Barry, John Griffiths, Assistant Professor, Electrical Engineering; B.S., George Washington University; M.S., Ph.D., University of Pennsylvania.

Bauman, Roger H., Professor, Electrical Engineering; B.S., M.S., Massachusetts Institute of Technology; Sc.D., University of Paris.

Bischoff, Frederick B., Professor, Mechanical and Energy Engineering; B.S., M.S., Lowell Technological Institute; P.E.

Brown, Gilbert, Professor, Mechanical and Energy Engineering B.S., Cornell University; M.S., Ph.D., Massachusetts Institute of Technology.

Brunelle, Ronald D., Associate Professor, Electrical Engineering; B.S., M.S. Lowell Technological Institute; P.E.

Burger, Peter, Electrical Engineering; B.E., Vanderbilt University; M.S., Ph.D., Stanford University.

Chang, Huan-Yang, Associate Professor, Chemical Engineering; B.S., Southwest Associated University (China); M.S., University of Rhode Island; Ph.D., Iowa State University.

Chen, Ning H., Professor, Chemical Engineering; B.S. National Chekiang University (China); B.Ch.E., Polytechnic Institute of Brooklyn; M.S., University of Missouri; D.Ch.E., Polytechnic Institute of Brooklyn.

Chen, S.J., Associate Professor, Plastics Engineering; B.S., National Taiwan University, M.S., California Institute of Technology, Ph.D., Kansas State University.

Cheney, George P., Assistant Professor, Electrical Engineering; B.S., M.S., Lowell Technological Institute.

Cirrito, Anthony J., Assistant Professor, Civil Engineering; B.S. Villanova University; M.S., Lowell Technological Institute; P.E.

Clark, Donn A., Associate Professor, Electrical Engineering; B.S., Pennsylvania State University; M.S. Northeastern University; P.E.

Colling, David, Assistant Professor, Industrial Technology; S.B., S.M., Sc.D., Massachusetts Institute of Technology; P.E.

Crugnola, Aldo M., Professor, Plastics Engineering; A.B., Boston University; M.S. Northeastern University; Sc.D., Massachusetts Institute of Technology.

Deanin, Rudolph D., Professor, Plastics Engineering; A.B., Cornell University; M.S., Ph.D., University of Illinois.

Dirkman, Robert J., Associate Professor, Electrical Engineering; B.S., Tufts University; S.M., Massachusetts Institute of Technology.

Donatelli, Alfred A., Associate Professor, Chemical Engineering; B.S., M.S., Lowell Technological Institute; Ph.D., Lehigh University.

Driscoll, Stephen B., Associate Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute.

Flanagan, James H., Associate Professor, Mechanical and Energy Engineering; Sc.B. Brown University; M.S., Harvard University.

Gartner, Nathan, Professor, Civil Engineering; B.S., M.S., Sc.D., Technion-Israel Institute of Technology.

Harcourt, Bernard C., Associate Professor, Industrial Technology; B.S., Fitchburg State College; M.A., Columbia University; P.E.

Haskell, Jr. William E., Professor, Civil Engineering; B.S., Tufts University; Ph.D., University of Massachusetts; P.E.; R.L.S.

Higgins, Charles J., Professor, Chemical Engineering; B.S., Massachusetts Maritime Academy; B.S., Lowell Technological Institute; P.E.

Hogan, William T., Professor, Mechanical and Energy Engineering; B.S., Northeastern University; S.M., D.Sc., Massachusetts Institute of Technology; P.E.

Hollenbach, Robert Z., Professor, Mechanical and Energy Engineering; S.B., Massachusetts Institute of Technology; M.S., Rensselaer Polytechnic Institute.

Holmstrom, F. Ross, Professor, Electrical Engineering; B.S., University of Washington; M.S., Ph.D., Stanford University.

Kamien, C. Zelman, Associate Professor, Mechanical and Energy Engineering B.S., M.S., Ph.D., Purdue University.

Keeney, Jr., Norwood H., Professor, Chemical Engineering; B.S., Trinity College, Hartford; M.S., University of Maine; Ph.D., University of Manchester (England); P.E.

Khazan, Alexander, Associate Professor, Electrical Engineering; M.S., Moscow University; Ph.D., Moscow Engineering Institute.

Kyros, William, Associate Professor, Mechanical and Energy Engineering; B.S., University of Lowell; S.M., Massachusetts Institute of Technology; Ph.D., Cornell University.

Laste, Jr., Earle R., Professor Electrical Engineering; B.S., M.S., Northeastern University; Ph.D., Worcester Polytechnic Institute.

Lemieux, J. Robert A., Associate Professor, Electrical Engineering; B.S., M.S., Lowell Technological Institute.

Leitch, Donald G., Associate Professor, Civil Engineering; B.S., Lehigh University; M.S., University of Colorado; P.E.

Leonard, John P., Assistant Professor, Electrical Engineering; B.S., Lowell Technological Institute; M.S. Northeastern University.

Mann, James A., Associate Professor, Chemical Engineering; B.S., Rensselaer Polytechnic Institute.

Martin, Jose G., Professor, Mechanical and Energy Engineering; A.S., A.S., Institute de la Habana; B.S., Mississippi State University; M.S., Ph.D., University of Wisconsin, Madison.

McElman, John A., Professor, Mechanical and Energy Engineering; B.S., M.S., Northeastern University; Ph.D., Virginia Polytechnic Institute.

Medhani, Rezene G., Assistant Professor, Civil Engineering; B.S., University of Addis Ababa (Ethiopia); M.S., Ph.D., University of Oklahoma.

Mironer, Alan, Professor, Mechanical and Energy Engineering; B.M.E., Rensselaer Polytechnic Institute; M.Eng., Yale University; Ph.D., Syracuse University.

Moeller, William B., Professor, Civil Engineering; B.S., Villanova University; M.S., Ph.D., University of Connecticut; P.E.

Murphy, Paul J., Associate Professor, Electrical Engineering; B.S., M.S., Massachusetts Institute of Technology; P.E.

Niemi, Jr., Eugene E., Associate Professor, Mechanical and Energy Engineering; B.S., Boston University; M.S., Worcester Polytechnic Institute; Ph.D., University of Massachusetts; P.E.

Normandin, Raymond O., Professor, Plastics Engineering; A.B., Saint Anselm's College; M.S., Boston College.

O'Callahan, John C., Professor, Mechanical and Energy Engineering; B.S., M.S., Ph.D., Northeastern University; P.E.

Orroth, Jr., Stephen A., Associate Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute.

Ott, Charles R., Professor, Civil Engineering; B.S., M.S., Ph.D., University of Washington.

Parkin, Robert E., Associate Professor, Electrical Engineering; B.Sc., Plymouth Polytechnic (London); Ph.D. and D.I.C., Imperial College (London).

Patt, Marin A., Assistant Professor, Electrical Engineering; B.S., Northeastern University; S.M., Massachusetts Institute of Technology.

Petrou, Arthur, Assistant Professor, Mechanical and Energy Engineering; B.S., University of New Hampshire; M.S., Northeastern University; P.E.

Pfister, David H., Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute; P.E.

Phelps, James P., Professor, Mechanical and Energy Engineering; University of Maine, Ph.D., Michigan State University.

Pope, Clarence J., Professor, Plastics Engineering; B.S., Clemson University; M.S., Lowell Technological Institute.

Powers, James E., Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute.

Prasad, Kanti, Associate Professor, Electrical Engineering; B.S., Agra University (India); Ph.D., University of South Carolina.

Richard, II, Roy V., Instructor, Mechanical and Energy Engineering; B.S., Lowell Technological Institute; M.S., The Catholic University of America.

Rogers, Kenneth L., Professor, Mechanical and Energy Engineering; B.S., University of Maine; P.E.

Rojak, Fredrick A., Associate Professor, Electrical Engineering; B.S., Pratt Institute; M.S., Lowell Technological Institute, P.E.

Rome, James H., Associate Professor, Electrical Engineering; B.S., M.S., Ph.D., University of Michigan.

Sama, Dominick A., Associate Professor, Chemical Engineering; S.B., S.M., Sc.D., Massachusetts Institute of Technology.

Schott, Nick R., Professor, Plastics Engineering; B.S., University of California, Berkeley; M.S., Ph.D., University of Arizona.

Segall, Burton A., Professor, Civil Engineering; B.C.E., Polytechnic Institute of Brooklyn, M.S.C., University of North Carolina; M.P.H., University of North Carolina; Ph.D., New York University.

Serabian, Steven, Professor, Mechanical and Energy Engineering; B.S., Rensselaer Polytechnic Institute; M.S., Union College.

Sewell, John J., Associate Professor, Civil Engineering; S.B., C.E., Massachusetts Institute of Technology.

Shea, Herman J., Professor, Civil Engineering; S.B., S.M., Massachusetts Institute of Technology; P.E.; R.L.S.

Sheff, James R., Associate Professor, Mechanical and Energy Engineering; University of Colorado; M.S., Ph.D., University of Washington.

Shreedar, Lele G., Associate Professor, Electrical Engineering; B.Sc., M.Sc., Banaras Hindu University (India); M.S.E., Ph.D., University of Michigan.

Sladek, Karl J., Associate Professor, Chemical Engineering; B.S., M.S., Sc.D., Massachusetts Institute of Technology.

Shepard, Dudley G., Professor, Mechanical and Energy Engineering; B.S., Yale University; M.S., Sc.D., Massachusetts Institute of Technology.

Spurk, Stephen J., Assistant Professor, Electrical Engineering; B.S., Merrimack College; M.S., University of New Hampshire.

Tartaglione, Louis C., Assistant Professor, Civil Engineering; B.S., Manhattan College; M.S., University of Connecticut; P.E.
 Tayebi, Amad, Professor, Plastics Engineering; B.S., Alexandria University (Egypt); M.S., M.E., Sc.D., Massachusetts Institute of Technology.
 Tran, Anh, Assistant Professor, Electrical Engineering; B.Sc., Natunai Taiwan University (Taiwan); M.S., Ph.D., University of Rhode Island.
 Wade, David P., Associate Professor, Electrical Engineering; B.S.; Lowell Technological Institute; M.S. Northeastern University.
 White, John R., Instructor, Mechanical and Energy Engineering; B.S., University of Lowell; M.S., University of Tennessee.
 Walkinshaw, John W., Associate Professor, Chemical Engineering; B.S., M.S., M.S., Lowell Technological Institute; Ph.D., University of Manchester (England).
 Wunsch, David A., Associate Professor, Electrical Engineering; B.E.E., Cornell University; S.M., Ph.D., Harvard University.
 Yeung, Woon-Shing, Assistant Professor, Mechanical & Energy Engineering; B.S., University of Lowell; M.S., University of California; Ph.D., University of California.
 Zilberberg, Yakov M., Assistant Professor, Mechanical & Energy Engineering; M.S., Technological Institute of Food and Refrigeration Industry (USSR); Ph.D., University of New Hampshire.

ADJUNCT FACULTY

Bellemore, Arthur J., Electrical Engineering; B.S., Lowell Technological Institute; M.S., University of Virginia.
 Brenner, John, Mechanical Engineering; B.S., Loyola University (Los Angeles); M.S., University of Notre Dame.
 Burtt, Frederick J., Mechanical Engineering, B.T.E., M.S., Lowell Technological Institute.
 Delizza, Cesare C., Mechanical and Energy Engineering; B.S., University of Lowell.
 Ellis, Edward J., Plastics Engineering; B.S., M.S., Ph.D., Lowell Technological Institute.
 Kacevich, Raymond S., Electrical Engineering; B.S., University of Hartford; M.S., Yale University.
 Mondano, Ralph, Plastics Engineering; B.S., Yale University.
 O'Brien, Joseph E., Civil Engineering; B.S., Tufts University; M.S., Massachusetts Institute of Technology; Ph.D., Harvard University.
 O'Neil, Robert E., Electrical Engineering; B.S., Northeastern University.
 Pilat, Edward E., Mechanical and Energy Engineering; B.S., Cornell University; M.S., Ph.D., Massachusetts Institute of Technology.
 Stevens, Carl A., Electrical Engineering; B.S., M.S., Tufts University; Sc.M., Brown University; Ph.D., Boston University; P.E.
 Thomas, Henry E., Plastics Engineering; B.T.E., Lowell Technological Institute; P.E.
 Vasilos, Thomas, Mechanical & Energy Engineering; B.S., Brooklyn College; Sc.D., Massachusetts Institute of Technology.
 Winfield, Armand G., Plastics Engineering; B.S., Franklin & Marshall College; F.P.R.I., Plastics & Rubber Institute (London).
 Woolfe, Stanley, Mechanical and Energy Engineering; Sc.B., Brown University; M.S., Tufts University; Ph.D., University of Lowell.

COLLEGE OF HEALTH PROFESSIONS

Eleanor Forsley Shalhoup, Dean

Sarah Moroney, Assistant Dean

The faculty of the College of Health Professions believe that each individual has the right to achieve and maintain an optimal level of health. As a response to society's need for individuals to exercise this right, the College of Health Professions provides programs to prepare health professionals.

These programs are based on the belief that preparation for professional practice requires the acquisition of theoretical knowledge and professional skill and opportunity to utilize these in supervised clinical and community settings. This integration of didactic and practicum experience encourages the development of professional attitudes and values.

Members of the College of Health Professions, through education, research, and community service, collaborate with health care professionals and consumers to assist in meeting the changing health needs of society.

OBJECTIVES OF THE COLLEGE OF HEALTH PROFESSIONS

The College of Health Professions:

- Prepares professionals in various health disciplines.

- Provides the students of each health discipline with a theoretical knowledge base and the opportunity to practice professional competencies in supervised practicums in a variety of settings.

- Fosters personal growth and the development of professional attitudes and values.

- Prepares students to provide leadership through education, research, and service in meeting the changing health needs of society.

- Encourages cooperation and collaboration among health professionals.

COLLEGE ORGANIZATION AND GOVERNANCE

The College of Health Professions is organized into five departments and is administered by a dean who is assisted by an executive committee. Each of the five departments is responsible for developing programs of studies and course offerings. Although the Faculty of the College has overall responsibility for all academic policies of the College, the Academic Standards Committee is responsible for enforcing the academic standards of the College and also serves as a review body for suspended students seeking readmission with probationary status. In addition, each department has its own Professional Review Committee which evaluates appeals from students who have not met the criteria for retention in their specific program. Such appeals to professional review committees may be submitted only once and all decisions of these committees are final.

Executive Committee

Eleanor F. Shalhoup, Dean

Richard Aronson, Chairperson, Physical Education

Joseph Dorsey, Chairperson, Clinical Laboratory Sciences

Joseph Farina, Chairperson, Clinical Laboratory Sciences

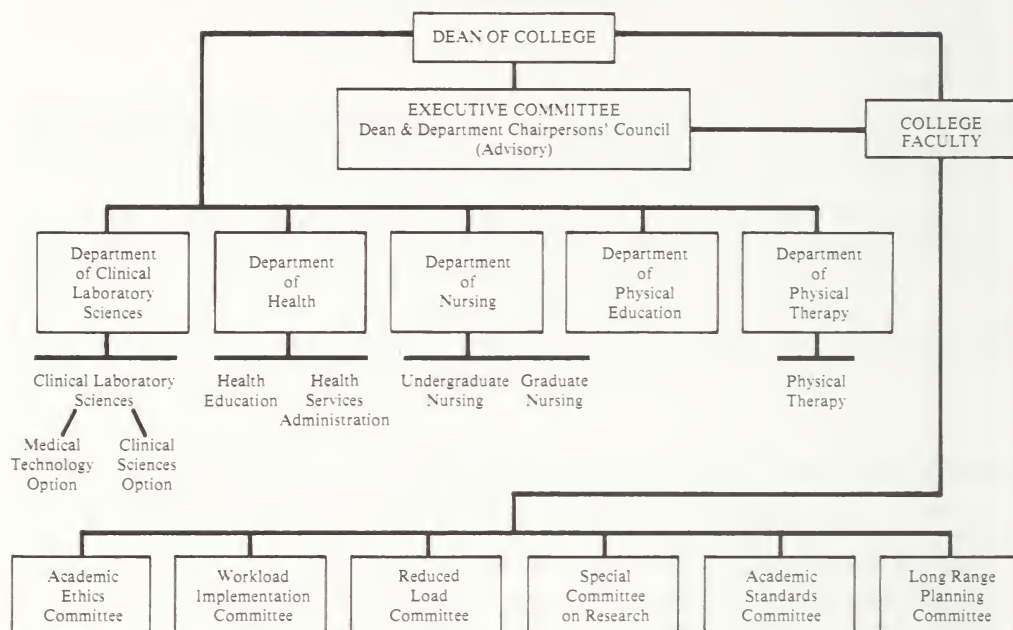
May Futrell, Chairperson, Nursing

Karen Lorentzen, Chairperson, Health

Advisory Councils

Each major of the College of Health Professions has an advisory council comprised of professionals distinguished in their fields.

ORGANIZATION CHART



BACCALAUREATE DEGREE PROGRAMS

The College of Health Professions offers undergraduate programs leading to the degree of Bachelor of Science. Degree programs are offered in Clinical Laboratory Sciences, Health Education, Health Services Administration (until class of 1985, after which it will be a graduate program only), Nursing, and Physical Therapy. For information concerning graduate offerings of the College, see the Graduate School Catalogue.

The course requirements for undergraduate programs of the College have been determined by specific professional objectives and are subject to the recommendations of the various professional accrediting associations. Each course of study provides a basic general education in the sciences, the psycho-social areas, and the humanities, a comprehensive introduction to the health professions, upper division professional courses, and clinical or teaching experiences in one or more community health agencies or schools.

Candidates for the Bachelor of Science degree in the College of Health Professions must comply with the University Core Requirements and with the rules and regulations of the College of Health Professions. The University Core Requirements are described elsewhere in this publication under the heading "Academic Policies".

Candidates for degrees in the College of Health Professions may be permitted to elect a second academic major in another college provided that all curriculum requirements of the College of Health Professions can still be satisfied. Election of a second major may require an extension of the normal four-year period of undergraduate study for all but the unusual student.

GENERAL COLLEGE REQUIREMENTS

Each candidate for a baccalaureate degree in the College of Health Professions must satisfy the general University requirements for graduation, complete all courses and credits as specified by the specific program of study, and meet the specific academic requirements of the College of Health Professions as specified in this section.

Retention and Continuance in College Programs

Irrespective of the classification policies of the University, students shall not be admitted to professional courses of the College unless they have satisfactorily completed all courses which are specified in their programs of study for the first three semesters and they have achieved a cumulative grade-point average of 2.50 or better for all such courses. Students enrolled in clinical laboratory sciences, nursing, and physical therapy programs also are required to achieve at this time a cumulative grade-point average of 2.50 or better in their required physical and biological science courses.

To qualify for continued matriculation in programs of the College of Health Professions, all students must maintain on-going cumulative averages of 2.50 or better by achieving the following averages at the end of the second semester of the sophomore year and at the end of each semester thereafter; (1) a semester average of 2.50 or better, (2) not less than a grade "C" in any professional major course and (3) a semester average of 2.50 or better for professional courses attempted in the major. Students who fail to satisfy these requirements will be dropped from their respective programs. Such students may seek reinstatement to programs by filing a petition with the Professional Review Committee of their department. Students whose petitions for reinstatement are denied may seek transfer to another college of the University if they qualify under University policies as students with satisfactory academic standing. Students who do not qualify for such standing are dismissed from the University at the time they are dropped from the College of Health Professions and are ineligible for readmission as probationary students under University policies.

All students in the College of Health Professions must demonstrate a state of emotional and physical health which will enable them to provide safe, competent practice in their chosen professional field. In special cases, at the request of the Professional Review Committee of the student's major department, an individual may be required to present statements of physical and/or mental health from appropriate physicians or psychiatrists who are fully licensed by the Commonwealth of Massachusetts. On the basis of a review of such statements, the Professional Review Committee may recommend to the chairperson of the student's major department that the individual be denied admission to or continuance in the major program and that his or her enrollment in the program be terminated.

Appeals Procedure for Reinstatement

Any student who has been denied continuance in his or her major, or any student who has been dropped from a major for non-academic reasons concerning emotional and/or physical health, may submit a written petition, in response to the letter of notification received, to the appropriate Professional Review Committee for reevaluation of his or her record for the purpose of reinstatement. This petition must be received no later than the date specified in the letter of notification and may be submitted only once. In making recommendation for reinstatement, the Professional Review Committee may recommend to the faculty specific requirements which the student must satisfy as a condition of his or her reinstatement. The faculty will vote to accept or reject the request for reinstatement. The faculty will vote to accept or reject the request for reinstatement and will forward to the Department Chairperson and the Dean its recommendations together with a statement of requirements which a reinstated student must satisfy as a special condition of his or her reinstatement and continued matriculation. A student who has been dropped from his/her program after having been reinstated may not petition again for reinstatement.

Academic Advising

Each student in the College of Health Professions is assigned an academic advisor. Prior to each registration period, students should meet with their advisors to discuss selection of courses required by their academic programs. Students who fail to avail themselves of this opportunity and who register for incorrect courses may find it necessary to extend their period of academic study. All seniors must consult with their advisors prior to the established University deadline for filing program of study forms with the Office of the Dean, College of Health Professions. The program of study summarizes a senior's status with respect to requirements of the curriculum and grade-point averages and insures that all stated requirements for graduation have been satisfied.

Declaration of Program and Change of Program

Students entering the College of Health Professions are advised to declare a major at the time of admission. Students interested in the health professions but who are unsure of a specific major may be admitted to the College as “undeclared health” students. Subsequent selection of a major by “undeclared health” students may be limited to either health education or health services administration due to non-availability of spaces in clinical laboratory sciences, nursing, or physical therapy programs.

All students are required to declare a major prior to the end of the sophomore year. Consequently, no student may retain the status of undeclared student later than the semester in which he or she has earned 60 credits. Whenever a student makes a declaration of major, he or she is required to file an official notification with the Office of the Registrar.

Students desiring to change their professional program within the College of Health Professions must secure the approval of the chairperson of the appropriate department. Students transferring to another major outside the College of Health Professions must apply for intercollegiate transfer. All changes of program require official notification to the Office of the Registrar.

Students who change their programs within the College of Health professions after the first semester of the sophomore year should expect possible additional course work beyond the minimum degree requirements and extension of the normal four-year period of study.

Transfer Policies

Qualified students may transfer into degree programs of the College of Health Professions from other colleges of the University provided they meet the requirements as stated. Irrespective of any previous recognition by the Office of Admissions or by other colleges of the University, a student transferring from another college of the University to the College of Health Professions must meet prerequisites and academic criteria for admission to programs of the College.

Students who contemplate transferring to one of the health professions majors of the College are advised that admission to the College is competitive and requires, as a minimum, the achievement of a cumulative grade-point average of 2.50 on a 4 point scale for all previous course work attempted. In addition, applicants for clinical laboratory sciences, nursing, and physical therapy programs are also required to have achieved a minimum of 2.50 in their science courses.

Transfer from Other Institutions

Courses transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University requirements. When students are admitted to the University, they are also evaluated by the professional department in terms of college and program requirements. Courses which are transferred to the University under provisions of the Massachusetts Transfer Compact and which are not equivalent to those of the College of Health Professions or as unrestricted elective courses will be listed on the students permanent record card but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University under the Massachusetts Transfer Compact subsequently makes an intercollegiate transfer to the College of Health Professions, all previously completed courses, including transferred courses from the compact institution, will be re-evaluated in terms of their applicability to degree requirements of the College of Health Professions.

The applicability of grades received in transferred courses for the determination of the grade-point average of the student's major at the University of Lowell is determined by policies of each of the colleges. The policy of the College of Health Professions is to count such grades for the purpose of determining the student's grade-point average in his or her professional major.

Repetition of Transferred Courses

A student who has been granted transfer credit, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take

a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form through the office of the College dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Health Professions

Students wishing to transfer from another college of the University, or from baccalaureate continuing education programs of the Evening School, must file a petition, together with a transcript of their permanent record cards, with the appropriate chairperson and the Dean of the College of Health Professions by November 1 for spring semester transfer and by April 1 for fall semester transfer. Students should refer to University policies concerning intercollegiate transfer "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Office of the Dean and, irrespective of grades previously received in other college programs, all courses which may not be applied to college or program requirements are deleted from the student's cumulative grade-point average.

Readmission Policies

Students who are readmitted into their major in the College of Health Professions must comply with the current program requirements of that major. Year of graduation based on the students previous matriculation date becomes null and void on readmission.

Special College Requirements

All students are expected to demonstrate behavior that is generally accepted as professional. In addition, each student in the majors of clinical laboratory sciences, health education, health services administration, nursing, and physical therapy must demonstrate proof of purchase of professional liability insurance at the beginning of their clinical experience. For physical therapy students this will be at the beginning of the sophomore year. For clinical laboratory sciences and nursing students, this will be at the beginning of their junior year; for health services administration and health education students, this will be at the beginning of the senior year. Students are billed for this insurance by the business office, but in case of error or omission, students are advised that they must assume personal responsibility for their coverage. The professional liability insurance is in the amount of \$1,000,000/\$1,000,000 aggregate.

In order to participate in the clinical portion of the upper-division curriculum, each clinical laboratory science, nursing and physical therapy student is required to wear an official school uniform, which may be purchased at the South Campus bookstore. Details concerning specific uniform requirements may be secured from the appropriate department chairperson.

All students must provide their own transportation to clinical placements. Car pools are often arranged among students and individuals who do not own automobiles usually can arrange to participate in such a pool.

Each student in the College of Health Professions must provide evidence that he or she is free of tuberculosis by presenting a skin test or x-ray report before enrolling in any clinical or apprentice teaching course. In addition, nursing and physical therapy majors must present a report of a complete physical examination before senior clinical experiences are scheduled. These reports are to be submitted to the University health office. Students are advised to consult department chairpersons for additional details.

INTERDISCIPLINARY OFFERINGS

Minor Program in Health

A minor in health consists of 20-23 credits, at least 6 credits of which must be taken at the "300" courses level or above. The minor is open to all students except those matriculated in the College of Health Professions. Course work for the minor is selected by the student in consultation with his advisor and the chairperson of the health department.

Required courses:	30-201 Community Health	(3)
	30-103 Life & Health	(3)
	30-101 Introduction to the Health Profession	(2)
	30-303 Fitness and Nutrition	(3)
Additional courses are selected from the following list:		
	30-306 Introduction to Gerontology	(3)
	30-550 Bio-Medical Aspects of Aging	(3)
	32-411 Health Law & Regulations	(3)
	30-406 Human Experience	(3)
	30-401 Research and Health Care	(3)
	31-301 Environmental & Consumer Health	(3)
	35-101/102 Principles of Anatomy & Physiology I and II	(6)
	(Students must elect <i>both</i> semesters of the sequence 35-101/102)	

Interdisciplinary Courses (Course Prefix: 30)

The following courses are offered by faculty of the several departments of the College of Health Professions and are available for election by students who are enrolled in other colleges.

30-101 INTRODUCTION TO HEALTH PROFESSIONS I,II(2,0)2

Introduces the student to the philosophy of health and human services in the United States, the philosophy of the College of Health Professions and of the Department of Health. Students will participate in various learning experiences that relate to their personal career choices and the various roles of health professions in the health field. Health Faculty (Open to the University)

30-103 LIFE AND HEALTH I or II(3,0)3

The major contemporary health problems facing the American people are discussed. Attention is focused on the prevention of these problems through the development of healthful habits at an early age. Epidemiological studies supporting the relationship between lifestyle and health are presented. Student are encouraged to apply the concepts learned to their holistic health, mental health, stress, drug and alcohol abuse, smoking, cancer and heart disease. Health Faculty.

30-201 COMMUNITY HEALTH I,II(3,0)3

Emphasizes the concepts, philosophy and principles of public health and the relationship to the physical, mental and social well-being of the community, its individuals, families and groups. The focus is on the prevention of disease, the promotion and maintenance of health and the provision of environmental and personal health services through organized community effort. Open to all students. Health and Nursing Staff.

30-301 CONTEMPORARY HEALTH PROBLEMS I or II(3,0)3

Restricted on the major contemporary health problems and disease that afflict people throughout the life cycle. The physical, mental and social etiology of disease is stressed with great emphasis in the area of prevention. A field presentation pertaining to course content is included. Health Faculty.

30-303 NUTRITION & PHYSICAL FITNESS I,II(3,0)3

Designed to show the relationship of nutrition to physical activity. An overview of basic activity, exercise, and fitness is provided. Open to all students. Dorsey.

30-306 INTRODUCTION TO GERONTOLOGY I or II(3,0)3

This course will examine human aging from a multi-disciplinary and developmental perspective. The course will focus on the adult years of the life span. The social-psychological factors involved in adjustments to the aging process, to retirement, to family, to leisure, to aloneness, to death and bereavement will be discussed together with such special concerns of the elderly as widowhood, finances, religion, sexuality, and health problems. Rehabilitative strategies such as remotivation and reality orientation are included. Open to all students. O'Rourke, Futrell.

DEPARTMENT OF CLINICAL LABORATORY SCIENCES

Alease Bruce, Chairperson

Professors: Joseph P. Farina, Jacob W. Lam

Associate Professors: Alease Bruce, Michael Frechette, Theodore Namm

Assistant Professors: Sandra Fessia, Jeffrey Kushner

Instructors: Kathleen Doyle, Eugene Rogers

The Department of Clinical Laboratory Sciences offers a major program in Medical Technology which leads to a Bachelor of Science degree. Students select one of two options.

Clinical Laboratory Sciences

Option I

Graduates of Option I are qualified to write either or both of the registry examinations sponsored by the American Society of Clinical Pathologists (M.T.ASCP) and/or the National Certifying Agency for Clinical Laboratory Personnel (CLS-NCA). This option provides the student with the scientific knowledge, technical skills, and hands-on experience required to function in all areas of the clinical laboratory. This integrated curriculum is offered in cooperation with the clinical laboratories of three local medical facilities: Lowell General Hospital, St. John's Hospital, and St. Joseph's Hospital.

On campus instruction provides students with didactic and simulated clinical laboratory experiences in each of the four major areas of the clinical laboratory: clinical chemistry, clinical hematology, clinical immunohematology, and clinical microbiology. Hospital-based clinical rotations are integrated with the didactic laboratory curriculum during the Junior and Senior years of the program. Students are advised that it may be necessary to schedule clinical rotations at times other than during the normal academic calendar.

This option also allows for upward mobility of current practitioners in the field including associate degree graduates with MLT(ASCP) certification or CLA(ASCP) certification. The growing complexity and significance of the role of the Clinical Laboratory in the delivery of health care accentuates the importance to its professionals receiving an education commensurate with the responsibilities of the clinical laboratory scientist. Medical technologists perform tests on various body fluids and tissues to determine the presence or absence of disease, to monitor response to disease, and to aid in health maintenance. They are the indispensable laboratory personnel - the supervisors, the instructors and /or the specialists for a wide range of complex diagnostic and therapeutic procedures.

Option II

Graduates of Option II, by integrating their clinical and non-clinical experiences, are prepared for graduate school and/or for industrial or government employment as research assistants, technical sales representatives, product development personnel, instrument designers, and/or technical service representatives. These students pursue a core of courses similar to students electing the medical technology option, but substitute, in lieu of clinical rotations, additional didactic, laboratory and/or experiential opportunities. While this option is not structured to prepare graduates for certification as medical technologists, it does provide them with an opportunity to specialize in any of the subject areas of clinical science.

Retention, Continuance, and Appeals Procedure

To qualify for continued matriculation in either Option I or II, all students must meet the academic criteria as specified in the retention and continuance policies for the College of Health Professions. Any student who has been denied continuance in either the medical technology option or the clinical sciences option for academic reasons or any student who has been dropped from either option for non-academic reasons, may appeal for reinstatement. The appeals procedure for reinstatement is outlined in the policies of the College of Health Professions.

Minor Program

Clinical Sciences

The Department of Clinical Laboratory Sciences offers a minor in "Clinical Sciences" which consists of no less than 18 semester hours; six of which must be completed at the "300" level or above. Typically, a minor in "Clinical Sciences" would consist of 12 semester hours from among the following:

35-101/102 Principles of Anatomy & Physiology I & II	6
35-103/104 Principles of Anatomy & Physiology Lab I & II	2
35-201/202 Human Anatomy & Physiology I & II	6
35-203/204 Human Anatomy & Physiology Lab I & II	2
35-211 Basic Clinical Microbiology & Pathology	3
35-213 Basic Clinical Microbiology & Pathology Lab	1
35-251/252 Physiological Chemistry I & II	6
35-253/254 Physiological Chemistry Lab I & II	2

and a minimum of six semester hours from among the following:

36-331 Clinical Immunology	
35-335 Medical and Clinical Genetics	3
35-356 Pharmacology	2
35-358 Environmental and Occupational Health	3
36-350 Human Biochemistry	3

Accreditation

The Department of Clinical Laboratory Sciences is accredited by the Committee on Allied Health Education and Accreditation (CAHEA) of the American Medical Association.

COURSE OF STUDY FOR CLINICAL LABORATORY SCIENCES, OPTION I

Freshman Year

Fall Semester

35-101 Anatomy & Physiology I	3
35-103 Anatomy & Physio. I Lab.	1
39-101 Physical Education	1
42-101 College Writing	3
47-101 General Psychology	3
48-101 Intro. to Sociology	3
92-121 Pre-Calculus Math.	3
(Area III)	

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Spring Semester

30-201 Community Health	3
35-102 Anatomy & Physiology II	3
35-104 Anatomy & Physio. Lab. II	1
35-273 Intro. to Medical Tech.	2
39-102 Physical Education	1
42-102 College Writing & Lit.	3
92-209 Intro. to BASIC	3
(or 261 Intro to Fortran or 263 Fortran Prog. Area III)	

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Sophomore Year

Fall Semester

35-211 Basic Clinical Micro. & Pathology	3
35-213 Basic Clinical Micro & Pathology Lab.	1
35-251 Physiological Chemistry I	3
35-255 Physio. Chem. I Lab.	1
42- Literature Elec. (Area II)	3
42- Humanities Elec. (Area II)	3
Elective (Area I or II)	3

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Spring Semester

35-252 Physiological Chem. II	3
35-256 Physiological Chem. II Lab	1
36-241 Basic Lab. Skills Lab.	2
36-243 Basic Lab. Skills Lab.	2
36-341 Fundamentals of Clinical Chemistry	3
36-343 Fund. of Clin. Chem. Lab.	2
Elective (Area I or II)	3

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Junior Year

Fall Semester

35-335 Medical & Clin. Genetics	3
36-321 Clinical Hematology	3
36-323 Clinical Hematology Lab.	2
36-350 Human Biochemistry	3
36-361 Medical Instrumentation	3
36-363 Medical Instr. Lab.	2

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Spring Semester

36-311 Medical Microbiology	3
36-313 Medical Microbiology Lab.	2
36-331 Clinical Immunology	3
36-351 Clinical Biochemistry I	3
36-353 Clinical Biochem. I Lab.	2
36-420 Clin. Hematology Practicum	2
36-474 Med. Tech. Seminar	1

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Senior Year

Fall Semester

36-410 Clinical Micro. Practicum	2
36-411 Advanced Med. Microbiology	3
36-413 Ad. Med. Microbiology Lab.	1
36-431 Clinical Immunohematology	3
36-433 Clin. Immunohemat. Lab.	2
36-452 Clinical Biochemistry II	3
36-454 Clin. Biochem. II Lab.	2
36-475 Med. Tech. Seminar	1

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Spring Semester

35-430 Clinical Immunohematology Practicum	2
36-450 Clinical Chemistry Prac.	2
36-453 Professional Aspects of Medical Technology	4
36-476 Med. Tech. Seminar	1
Elective (free)	3

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COURSE OF STUDY FOR CLINICAL LABORATORY SCIENCES, OPTION II

Freshman Year

Fall Semester		Spring Semester	
*35-101 Anatomy & Physiology I	3	30-201 Community Health	3
*35-103 Anatomy & Physio. I Lab.	1	*35-102 Anatomy & Physiology II	3
39-101 Physical Education	1	*35-104 Anatomy & Physio. II Lab.	1
42-101 College Writing	3	39-102 Physical Education	1
47-101 General Psychology (Area I)	3	42-102 College Writing & Lit.	3
48-101 Introduction to Sociology (Area I)	3	42- Literature Elective (Area II)	3
92-383 Introduction to Statistics (Area III)	3	92-131 Calculus I (Area III)	3
17		17	

Sophomore Year

Fall Semester		Spring Semester	
*35-211 Basic Clinical Micro. & Pathology	3	*35-252 Physio. Chemistry II	3
*35-213 Basic Clinical Micro. & Pathology Lab.	1	*35-256 Physio. Chemistry II Lab.	1
*35-251 Physiological Chemistry I	3	*36-341 Fundamentals of Clinical Chemistry	3
*35-255 Physio. Chem. I Lab.	1	*36-343 Fund. of Clin. Chem. Lab.	2
Humanities Elec. (Area II)	3	92-209 Intro. to BASIC	3
		(or 261 Intro. to Fortran or	
		263 Fortran Prog. Area III)	
95-103 General Physics I (Area III)	1	95-104 General Physics II	3
96-103 General Experimental Physics I (Area III)	1	96-104 General Experimental	
Physics I (Area III)	1		
Elective (Area I or II)	3	Physics II (Area III)	1
18		16	

Junior Year

Fall Semester		Spring Semester	
*35-335 Medical & Clin. Genetics	3	36-311 Medical Microbiology	3
36-321 Clinical Hematology	3	36-313 Medical Microbiology Lab.	2
36-323 Clinical Hematology Lab.	2	36-331 Clinical Immunology	3
*36-350 Human Biochemistry	3	36-351 Clinical Biochemistry I	3
36-361 Medical Instrumentation	3	36-353 Clin. Biochemistry I Lab.	2
36-363 Med. Instrumentation Lab	2	**Clinical Sciences	3-5
16-18		Specialization	16-18

Senior Year

Fall Semester		Spring Semester	
36-451 Clinical Biochemistry II	3	36-484 Senior Research	2
36-453 Clin. Biochemistry II Lab.	2	**Clin. Sciences Spec.	3-5
36-483 Senior Research	2	**Clin. Sciences Spec.	3-5
**Clin. Sciences Spec.	3-5	Elective (Area I or II)	3
**Clin. Sciences Spec.	3-5	Elective (free)	3
16-22		14-18	

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*or equivalent course (must have departmental approval).

**Students must select one course from each of the following three "Areas of Specialization", and a minimum of three additional courses in their chosen Area of Specialization.

Area of Specialization - CLINICAL MICROBIOLOGY

36-411 Advanced Medical Laboratory	3	84-426 Bioinorganic Chemistry	2
36-413 Advanced Medical Microbiology Laboratory	1	84-434 Colloid Science &	
81-327 Histology	3	its Environmental Applications	3
81-329 Histology Laboratory	3	84-484 Elements of Radiochemistry	3
81-329 Histology Laboratory	1	Area of Specialization — CLINICAL HEMATOLOGY	
81-442 Cytology	3	IMMUNOHEMATOLOGY	
81-444 Cytology Laboratory	1	36-431 Clinical Immunohematology	3
81-472 Virology	3	36-433 Clinical Immunohematology Laboratory	2
81-474 Virology Laboratory	1	36-441 Principles of Immunodiagnosis	3
81-561 Electron Microscopy	3	81-486 Cellular Immunology	3

Area of Specialization — CLINICAL CHEMISTRY

84-221 Organic Chemistry I	3	82-588 Cellular Immunology Laboratory	1
84-229 Organic Chemistry I Laboratory	1	81-522 Erythropoiesis	3
84-222 Organic Chemistry II	3	81-524 Erythropoiesis Laboratory	
84-228 Organic Chemistry II Laboratory	1		
84-324 Principles of Analytical Chemistry	4		
84-342 Organic Qualitative Analysis	3		

**Lecture sections and co-requisite laboratories together count as one course.

Clinical Sciences (Course Prefix: 35)

35-101 ANATOMY & PHYSIOLOGY I

I,II(3,0)3

An introduction to the study of the human organism relating structure and function. The topics treated are cytology, histology, the skeletal system, the muscular system, body plan, the nervous system and the endocrine system. This course is designed to provide students with a working knowledge of human anatomy and physiology through an understanding of the fundamental principles involved in the structure and function of the body, through interrelationships and through feedback mechanisms. Clinical applications will be presented. Corequisite: 35-103, Bruce, Farina, Namm.

35-102 PRINCIPLES OF ANATOMY & PHYSIOLOGY II

II(3,0)3

A continuation of the study of the human organism relating structure and function. The topics treated are the circulatory, respiratory, digestive, excretory, and reproductive systems of man. The course is designed to provide students with a working knowledge of human anatomy and physiology through an understanding of the fundamental principles involved in the structure and function of the body, through interrelationships and through feedback mechanisms. Clinical applications will be presented. Prerequisites: 35-101, 103. Corequisite: 35-104. Bruce, Farina, Namm.

35-103 PRINCIPLES OF ANATOMY & PHYSIOLOGY LABORATORY I

I(0,3)1

The laboratories are designed to reinforce didactic material by practical exposure to the subject matter. A second major outcome will be an understanding of laboratory methodology - viz. a thoughtful approach to problems, precise procedures and an appreciation of variables. Corequisite: 35-101. Staff.

35-104 PRINCIPLES OF ANATOMY & PHYSIOLOGY LABORATORY II

II(0,3)1

The laboratories are designed to reinforce didactic material by practical exposure to the subject matter. A second major outcome will be an understanding of laboratory methodology — viz. A thoughtful approach to problems, precise procedures and an appreciation of variables. Prerequisite: 35-101, 103, Corequisite: 35-102. Staff.

35-201 HUMAN ANATOMY & PHYSIOLOGY

II(3,0)3

Human Anatomy & Physiology is a two-semester sequence which covers the basic structure and function of the human body. First semester topics include basic body plan, cell anatomy, cell physiology, histology and the integumentary system, skeletal system muscular system, nervous system, endocrinology and special sensory system. Prerequisite: 84-112 or equivalent. Corequisite: 35-203. Bruce, Farina, Namm.

35-203 HUMAN ANATOMY & PHYSIOLOGY LABORATORY I

II(0,3)1

The laboratories are designed to reinforce material covered in lecture with practical exposure to the subject matter. Another outcome will be the understanding of and the practical application of basic laboratory techniques and methodology. Corequisite: 35-201. Staff.

35-202 HUMAN ANATOMY & PHYSIOLOGY II

I(3,0)3

Human Anatomy & Physiology II is a continuation of the study of the human organism, relating structure and function. Among the topics treated will be the circulatory, respiratory, digestive, excretory, and reproductive systems of man. Homeostasis and fluid and electrolyte balance will be emphasized. Corequisite: 35-204. Bruce, Farina, Namm.

35-204 HUMAN ANATOMY & PHYSIOLOGY II LABORATORY

I(0,3)1

This course is designed to provide the student with an understanding of laboratory methodology - viz. a thoughtful approach to problems, precise procedures and an appreciation of variables. Prerequisite: 35-203. Corequisite: 35-202. Staff.

35-211 BASIC CLINICAL MICROBIOLOGY & PATHOLOGY

I,II(3,0)3

This course is designed to study the fundamentals of microbiology with major emphasis on structure, function, growth, metabolism and classification of clinically important microorganisms. The human body's response to invading microbes, and an introduction to the ecological aspects of microorganisms in the environment with particular stress on their significance, activities (beneficial and detrimental) and control measures will also be studied. Prerequisites: 35-102, 104, Corequisite: 35-213. Lam, Fessia.

35-213 BASIC CLINICAL MICROBIOLOGY & PATHOLOGY LABORATORY

I,II(0,3)1

Laboratory investigations of basic properties and characteristics of microorganisms are conducted. Students will perform commonly used techniques for collecting, handling and studying clinically important microorganisms. Prerequisites: 35-102, 104. Corequisite: 35-211. Staff.

35-251 PHYSIOLOGICAL CHEMISTRY I**I(3,0)3**

This is an introductory chemistry course designed for students majoring in the associated health sciences. Basic concepts will be covered including: properties of matter, energy, atomic and molecular structure, chemical bonding, periodic table, chemical formulae, and reactions. Radioisotopes and radioactive decay will be discussed along with therapeutic applications. The properties of water and solutions will be studied including: osmosis, dialysis, chemistry of acids, bases and buffers will be covered with specific reference to blood and intracellular buffers, acid/base balance, compensation mechanisms, and diagnosis of fluid and acid/base disturbances. An introduction to organic chemistry will be provided and will include a discussion of the chemistry of carbon and a survey of the properties and reactions of the major functional groups. Aspects of the chemistry of natural products such as alkaloids, terpenes and vitamins will be studied. Prerequisite: 35-102. Corequisite: 35-253 or 35-255. Frechette, Rogers.

35-252 PHYSIOLOGICAL CHEMISTRY II**II(3,0)3**

This is a course designed to cover the basic aspects of biochemistry with a strong clinical emphasis. Amino acid and protein structure will be studied. The structure and function of enzymes, the factors which affect their reactions and the diagnostic use of enzyme assays in clinical medicine will be covered. Plasma proteins, hemoglobin, chemistry of nucleic acids, protein catabolism and selected pathological conditions connected with proteins are stressed. The chemistry of carbohydrates and lipids and their major metabolic pathways are studied with clinical applications and correlations with various disease states. Interpretations of selected clinical laboratory tests are included. Hormonal secretion, target specificity, mechanisms of control and specific mechanisms of action of the major hormones which affect protein, carbohydrate and lipid metabolism are studied, along with disease states which alter hormone balance. Recent studies from the current literature are included wherever possible. Prerequisite: 35-251. Corequisite: 35-254 or 35-256. Frechette, Rogers.

35-253 PHYSIOLOGICAL CHEMISTRY I LABORATORY**I 0,3)1**

Laboratory experiments are conducted to complement the material covered in 35-251. Exercises dealing with properties of matter, chemical equations, qualitative analysis, energy, osmosis, chemical equilibrium and acids/bases/buffers will be performed. The qualitative properties of alcohols, aldehydes, ketones, acids and esters will be explored. Corequisite: 35-251. Staff.

35-254 PHYSIOLOGICAL CHEMISTRY II LABORATORY**II 0,3)1**

Laboratory experiments are conducted to complement the material covered in 35-252. The chemistry of the basic biochemical molecules will be explored, including proteins, enzymes, carbohydrates, lipids and nucleic acids. Selected aspects of metabolism and the assay of clinically significant materials will be studied. Prerequisite: 35-253 or 35-255. Corequisite: 35-252. Staff.

35-255 PHYSIOLOGICAL CHEMISTRY I LABORATORY**II 0,3)1**

Similar to 35-253. Clinical Science majors only. Corequisite: 35-251. Staff.

35-256 PHYSIOLOGICAL CHEMISTRY II LABORATORY**II 0,3)1**

Similar to 35-254. Clinical Science majors only. Corequisite: 35-252. Staff.

35-273 INTRODUCTION TO MEDICAL TECHNOLOGY**II(1,2)2**

A course designed to introduce students to aspects of the Medical Technology profession. Topics include the basic clinical laboratory, discussions, demonstrations, field trips, guest lecturers and selected readings. Rogers.

35-335 INTRODUCTION TO MEDICAL & CLINICAL GENETICS**I(3,0)3**

A course designed to exemplify the pathological and clinical aspects of genetics. Background material includes an introduction to cellular and molecular genetics and the metabolic basis of inherited diseases. Immunogenetics, pathological genetics, the influence of chromosome variations on disease conditions, the care and treatment of genetically-based diseases, and the application of genetic precepts to the clinical laboratory will be discussed. The student will learn the psychology, sociology and biology of genetic counseling and learn to apply these principles to everyday situations. The legal implications of genetic decisions will also be discussed in light of recent experimentation being done on the genetic alteration of pharmacological responses, recombination, cloning and other forms of genetic engineering. Prerequisite: 35-102, 35-251/253. Namm.

35-356 PHARMACOLOGY**II(3,0)3**

An introduction to the chemistry, biochemistry and physiological actions of various pharmaceuticals. Fundamental concepts will be stressed and will include a discussion of drug receptors, drug receptor interactions, pharmacokinetics, enzyme induction, drug metabolism, drug safety and effectiveness and idiosyncratic reac-

tions. Several major groups of drugs will be studied including: central nervous system stimulants, hypnotics, narcotic analgesics, anti-inflammatory drugs, cholinergics, adrenergics, adrenergic blocking drugs, antihypertensives, antihistamines, diuretics, adrenal steroids, anti-anemic drugs and antibiotics. Articles from the current literature will be discussed. Prerequisite: 35-252. Rogers.

35-358 ENVIRONMENTAL AND OCCUPATIONAL HEALTH

II(3,0)3

This course is concerned with the interaction of man and his environment as it affects his physical and mental health and social wellbeing. Environmental conditions that foster the transmission of communicable diseases and exposure to toxic chemicals and hazardous conditions are reviewed. Discussion will center on pulmonary irritants, fibrosis, fever and granuloma-producing agents and mutagenic and carcinogenic substances. Specific effects of smoking, noise pollution, stress, economic poisons and various systemics will be covered. Lectures will focus on the occurrence of various pollutants and stresses, their specific health consequence to humans and the prophylaxis and treatment of these diseases. Applications will deal with both the external and internal environment. Specific occupational health hazards and their consequences will be studied. Prerequisite: 35-252 or permission of instructor. Frechette.

Medical Technology (Course Prefix: 36)

36-241 BASIC LABORATORY SKILLS

II(2,0)2

This course is designed to develop and refine specific areas of knowledge and skills required by the clinical laboratory scientist, and includes an introduction to the basic principles of DC and AC electricity, including the concepts of voltage, current, resistance, induction, capacitance, Ohm's and Kirchoff's Law, RC and RL transient analysis and solid state devices, such as diodes, transistors and integrated circuits. Among its objectives, the course is designed to establish an appreciation of the interrelatedness of electrical concepts with electronic components for the operational theories of analytical instrumentation. Corequisite: 36-243. Farina.

36-243 BASIC LABORATORY SKILLS LABORATORY

II 0,4)2

A laboratory course designed to expose prospective Medical Technologists to many of the essential skills, methods and procedures basic to professional performance in the clinical laboratory; to explain and demonstrate to students and have them perform these methods to develop basic technical abilities useful in diagnostic laboratory work; to provide an understanding of these techniques and to provide a technical background and approach to testing that the student can build upon and use in future courses. Prerequisite: 35-252/256. Corequisite: 36-241. Staff.

36-311 MEDICAL (CLINICAL) MICROBIOLOGY I

II(3,0)3

A study of the cultural, biochemical, serological and pathogenic characteristics of disease producing microorganisms. Emphasis will be placed on the pathophysiology of the infectious diseases and their relationship to isolation and identification of the pathogenic microorganisms. Prerequisites: 35-211/213. Corequisite: 36-311. Lam. Fessia.

36-313 MEDICAL (CLINICAL) MICROBIOLOGY LABORATORY I

II(0,6)2

This course is designed to introduce the student to pathogenic microorganisms, media and techniques used in the identification of these organisms. Emphasis will be based upon the isolation, identification and differentiation of pathogenic microorganisms common to man. In addition, quality control and antimicrobial susceptibility testing will be covered. Corequisite: 36-311. Lam, Fessia, Staff.

36-321 CLINICAL HEMATOLOGY

I(3,0)3

A study of the human hematopoietic system and its relationship to other organ systems. Discussions will include morphological and biochemical relationship of erythropoiesis and leukopoiesis in health and disease states. A study of the mechanics of blood coagulation as it relates to health and disease states will also be included. Prerequisites: 35-102/104, 35-252/256. Corequisite: 36-323. Kushner.

36-323 CLINICAL HEMATOLOGY LABORATORY

I 0,6)2

This course is designed to emphasize current hematological and coagulation procedures used in today's clinical laboratory. The implications of these tests to diagnose, monitor and evaluate the various hematological disorders will be discussed. Corequisite: 36-321. Kushner.

36-331 CLINICAL IMMUNOLOGY

II(3,0)3

An introduction to the principles of Immunology including: the study of antigens and antibodies, their interactions and controls; description of cellular events and the immune response; *in vivo* and *in vitro* antigen-antibody interactions with clinical relevance. Prerequisite: 35-211/213. Corequisite: 36-333. Bruce.

36-333 CLINICAL IMMUNOLOGY LABORATORY

II(0,4)2

A study of the antibody-antigen reactions and the use of current techniques employed for their assay. Methodologies and applied techniques for the blood bank, demonstration via such techniques as precipitation, agglutination, complement fixations will be studied. Corequisite: 36-331. Staff.

36-341 FUNDAMENTALS OF CLINICAL CHEMISTRY

II 3,(0)3

A course designed to prepare the student for advanced study in clinical chemistry and human biochemistry. The introductory principles of organic chemistry covered in 35-251 will be expanded. The chemistry of carbon compounds, bonding in organic compounds and the concept of isomerism will be studied. Detailed information of each of the classes of organic compounds including: hydrocarbons, halides, alcohols, ethers, aldehydes, ketones, carboxylic acids and their derivatives, etc. will be presented. Emphasis in each of these areas will be on nomenclature, chemical and physical properties, structure and general reaction mechanisms. Spectral techniques currently used to elucidate the structure of organics will be discussed including infra-red, NMR and mass spectroscopy. Selected examples of important reactions in clinical chemistry and human biochemistry will be studied. Prerequisite: 35-252/256. Corequisite: 36-343. Frechette.

36-343 FUNDAMENTALS OF CLINICAL CHEMISTRY LABORATORY

II(0,6)2

Laboratory exercises designed to complement the material covered in 36-341. Corequisite: 36-341. Frechette, Staff.

36-350 HUMAN BIOCHEMISTRY

I(3,0)3

This course is an in-depth study of biochemical substances and their reactions in the body, with major emphasis placed on metabolism at the cellular level, and examined in the tissues of the various organs where these reactions occur. Correlation of biochemical processes underlying pathologic conditions will be made whenever practical. Prerequisite: 35-252/256. 36-341/343. Kushner.

36-351 CLINICAL BIOCHEMISTRY I

II(3,0)3

This course deals with the methodology testing for and the interpretation of results for each of the following classes of compounds: carbohydrates, enzymes, proteins, non-protein nitrogen compounds, porphyrins and lipids. Prerequisites: 36-341/343, 36-350/363. Corequisite: 36-353.

36-353 CLINICAL BIOCHEMISTRY LABORATORY I

II 0,(6)2

This course is designed to introduce clinical laboratory procedures by studying the following compounds: carbohydrates, proteins, non-protein nitrogen compounds, porphyrins and lipids. Methods for troubleshooting, calibration and quality control will be emphasized. Prerequisites: 36-341/343. Corequisite: 36-351. Staff.

36-361 MEDICAL INSTRUMENTATION

I(3,0)3

A course designed to provide an in-depth knowledge of Clinical Laboratory instrumentation. Both theoretical concepts and practical applications will be stressed. The theory, operation, calibration and applications of various types of spectrophotometers will be covered, including: UV-VIS, fluorometry, nephelometry, IR, flame emission and atomic absorption. Electrochemical techniques studied will include: reference and pH electrodes, ion-selective electrodes and ion selective and electrode analyzers, coulometry, enzyme electrodes and electrochemical analyzers. The theory of absorption, partition, ion exchange and size exclusion chromatography will be discussed. Various forms of chromatography and chromatographic instrumentation will be studied including: paper and thin layer techniques, gas/solid and gas/liquid chromatography, high pressure liquid chromatography and applications in the clinical laboratory. The design of continuous flow system, discrete analysis system and centrifugal analyzers will be included. Corequisite: 36-363. Frechette.

36-363 MEDICAL INSTRUMENTATION LABORATORY

I(0,4)2

A course designed to complement the material covered in 36-361. The laboratory is conducted as a self-paced program and includes experimental work on UV-VIS spectrophotometers, fluorometers, infra-red techniques, flame emission, atomic absorption, potentiometry, Nova Electrolyte System, column chromatography, gas chromatography, and high pressure liquid chromatography. A special project in the area of laboratory instrumentation is required. Corequisite: 36-361. Frechette. Rogers.

36-410 CLINICAL MICROBIOLOGY PRACTICUM

I(0,6)2

Supervised clinical training in a consoritial hospital clinical laboratory, designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical microbiology laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation. Prerequisites: 36-311/313. Staff.

- 36-411 ADVANCED MEDICAL MICROBIOLOGY** I(3,0)3
Intensive study of classification, morphology, physiology, genetics and ecology of medically important fungi, parasites and viruses. Emphasis on epidemiology, pathogenicity and host defense. Prerequisites: 36-311/313. Corequisite: 36-413. Lam, Fessia.
- 36-413 ADVANCED MEDICAL MICROBIOLOGY LABORATORY** I(0,4)1
The laboratory is designed to emphasize principles and procedures used in the isolation, cultivation, and identification of medically important fungi and parasites. Corequisite: 36-411. Lam, Fessia.
- 36-420 CLINICAL HEMATOLOGY PRACTICUM** II(0,6)2
Supervised clinical training in a consorial hospital laboratory. Designed to reinforce knowledge and skills gained in lecture laboratory and at the same time introduce the student to the daily activities of a clinical hematology laboratory. Emphasis will be placed on quality control, methodology, and clinical interpretation. Prerequisites: 36-321/323. Staff.
- 36-430 CLINICAL IMMUNOHEMATOLOGY PRACTICUM** II 0,6)2
Supervised clinical training in a consorial hospital clinical laboratory, designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical immunohematology laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation. Prerequisites: 36-331, 332, 431, 433. Staff.
- 36-431 CLINICAL IMMUNOHEMATOLOGY** I(3,0)3
Lecture and case study discussions look at the major red cell antigen systems which are of importance in understanding transfusion therapies and compatibility testing. Emphasis is on differentiation and clinical significance of each system. Also discussed are HLA platelet antigens, and serologic tests which make use of immunologic principles. Prerequisites: 36-331/333. Corequisite: 36-433. Doyle.
- 36-433 CLINICAL IMMUNOHEMATOLOGY LABORATORY** I(0,4)2
Practical laboratory experience in blood banking and serology illustrating the concepts stressed in the lecture. Prerequisite: 36-331/333. Corequisite: 36-431. Doyle.
- 36-441 PRINCIPLES OF IMMUNODIAGNOSIS** I(3,0)3
This course is designed for the student of laboratory medicine who wishes to better understand and utilize the analytical capabilities of immunological tests. The course emphasizes the basic concepts of protein chemistry and immunology that are necessary for the understanding of clinical applications. Currently employed immunodiagnostic techniques will be reviewed, describing principle, methodology, inferences, clinical correlations, and interpretations. Prerequisite: 36-333 or lab experience. Fessia.
- 36-450 CLINICAL BIOCHEMISTRY PRACTICUM** II(0,6)2
Supervised clinical training in a consorial hospital clinical laboratory. Designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation. Prerequisites: 36-452. Staff.
- 36-451 URINALYSIS PRACTICUM** IIB(0,6)0
A one week clinical rotation designed to give the student experience in microscopic examination and evaluation of urine sediments. Emphasis is on correlating physical and chemical characteristics with sediment evaluation and diagnoses. Additional routine tests of a physical and chemical nature will be performed and demonstrated. Prerequisites: 36-452/454. Staff.
- 36-452 CLINICAL BIOCHEMISTRY II** I(3,0)3
Topics include methodologies and clinical correlations in the area of: urinalysis, acid base balance, electrolytes, hormones, toxicology, vitamins, gastric analysis, amniotic fluid and biochemical profiles. Prerequisites: 36-354/351/353. Corequisite: 36-454. Rogers.
- 36-453 PROFESSIONAL ASPECTS OF MEDICAL TECHNOLOGY** II(3,0)3
This course emphasizes classroom technological concepts which are outside of the usual classroom exposure. Centered around a professional philosophy which includes continued awareness of the technical field, the course emphasizes topics such as education and teaching, applications of management concepts to the laboratory, and research perspectives which ensure the ability of these students to develop professionally and give them the potential to encourage others in the profession. Staff.
- 36-454 CLINICAL BIOCHEMISTRY LABORATORY II** I(0,6)2
This course is designed to instruct the student in the analytical procedures and methods currently used in the clinical laboratory, and is a continuation of 36-353. Manual and automated methods utilized in the assessment of

such topics as acid-base balance, hormones, toxicology and vitamins will be introduced. In addition, methods associated with the routine examinations of urine will be introduced. Quality control, laboratory safety and professional performance are emphasized. Prerequisite: 36-353. Corequisite: 36-452. Rogers, Staff.

36-461 AUTOMATION

I(0,4)2

This course is designed to acquaint the student with current theories and methods of automated instrumental analysis as it currently applies to the clinical laboratory. Course work will include the assembly, maintenance, calibration, and quality control of such instrumentation, as well as a term project designed to adapt instrumental analysis to automated methodologies, lectures and laboratory. Prerequisite: 36-454. Staff.

36-473 (A B C) MEDICAL TECHNOLOGY SEMINAR

I, II(3,0)1

Medical technology students are introduced to aspects of the profession which may be influential to their status as professionals; credentialing; legal aspects; ethics; and other topics of selected interest. Staff.

36-483 SENIOR RESEARCH

I(0,6)2

Students along with their faculty advisor will structure a research project commensurate with the student's area of specialization. A paper embodying the results of the research project will be presented to the senior research project committee. Staff.

36-484 SENIOR RESEARCH

II(0,6)2

Continuation of 36-483. Staff.

36-493 DIRECTED STUDIES

I, II(0,6)3

Students along with their faculty advisor will structure an acceptable project in one of four areas: research, program development, teaching, or clinical practicum. Students are eligible to receive from 1 to 3 credits in accordance with departmental policy. Staff.

DEPARTMENT OF HEALTH

Karen M. Lorentzen, Chairperson

Professor: Mona C. Hull

Associate Professors: Karen Lorentzen, Robert Neal

Assistant Professor: Linda Roemer

The faculty of the Department of Health believes that each individual is a unique, rational human being who must have the opportunity to interact effectively within a changing environment. Individuals possess innate rights, one of which is the attainment of the goal of optimal health. Society, through its community and educational institutions, has a responsibility to make available for its citizens the methods and means for achieving the goals for optimal level of health. To this end, the Department of Health is committed to prepare professional practitioners who from their own health practice discipline assist the individual, the family, the group and the community to achieve as high a level of health as possible.

The Department of Health offers major programs in health education which lead to the degree of Bachelor of Science. The Department of Health also offers a continuing program in Health Services Administration which leads to the degree of Bachelor of Science until May of 1985.

Health Education Major

The health education major is a dual program which encompasses both community and secondary school health education and prepares graduates to establish and teach health programs in the public schools and community agencies such as public health departments, hospitals, industry, college health services and health maintenance organizations.

Health education has emerged as an educational discipline to effectively meet society's ever-increasing need for accurate health knowledge. Health education builds its body of knowledge on the arts and sciences and deals with the theory of health science. The application of this theory to practice requires the development of necessary effective teaching skills. These skills include the knowledge of developing curriculum based on health theory. This application also requires the acquisition of a variety of teaching and evaluation skills that are integral to effective health education. In addition, health-based curriculum and teaching plans for changing negative health attitudes and behavior are developed to reinforce existing positive health attitudes and behavior. Health educators must be able to communicate effectively, particularly in the areas of public speaking and be able to maintain good relations with people of all ages. The goal of the health education program is to prepare entry level professional prac-

tioners who have a foundation for continuing professional development and individual growth in addition to the ability to function effectively in a variety of settings.

At the completion of the health education program, the graduating student will be expected to:

- Teach effectively and demonstrate mastery in the major areas of the health education curriculum;
- Incorporate in the teaching process and interactions with people the broad-based areas of knowledge existing in the liberal arts and biological sciences;
- Recognize and acknowledge the multi-cultural diversity of populations and incorporate this understanding into educational and professional practices;
- Assess needs effectively and develop, present, and evaluate health education programs;
- Demonstrate knowledge about current trends and issues in the areas of general education and health education for continued professional and personal growth;
- Be an active participant in developing national awareness for disease prevention and increasing the quality of life for all citizens, individually and collectively, through health education.

Retention, Continuance, and Appeals Procedure

To qualify for continued matriculation in the health education program, all students must meet the academic criteria as specified in the retention and continuance policies for the College of Health Professions (page 314).

Any student who has been denied continuance in the health education major for academic reasons, or any student who has been dropped from the program for non-academic reasons, may appeal for reinstatement. The appeals procedure for reinstatement is outlined in the policies of the College of Health Professions (page).

Application for Professional Certification

Upon completion of a baccalaureate degree program in the College of Health Professions, health education major, senior students may file for professional certification to teach in Massachusetts. When the application materials are complete, the College will recommend the student for a teaching certificate and the appropriate endorsement will be entered on his/her permanent record card. The Massachusetts Department of Teacher Certification has the sole legal responsibility for granting certification.

COURSE OF STUDY FOR HEALTH EDUCATION*

Freshman Year

Fall Semester

30-101 Introduction to Health Prof.	2
35-101 Anatomy & Physiology	3
35-103 Anat. & Physio. Lab I	1
39- Physical Education	1
42-101 College Writing	3
47- Psychology Elective	3
48- Sociology Elective	3
	16

Spring Semester

30-201 Community Health	3
35-102 Anatomy & Physiology II	3
35-104 Anat. & Physio. Lab II	1
Elective	3
Humanities Elective (Area III)	3
39- Physical Education	1
42-102 College Writing & Lit.	3
	17

Sophomore Year

Fall Semester

01-361 Measurement & Evaluation	3
31-303 Contemporary Health Prob.	3
35-211 Basic Clinical Microbiology & Pathology	3
35-213 Basic Cl. Micro & Path Lab	1
35-251 Physiological Science I	3
35-253 Physiological Science I Lab	1
Elective (Area II)	3
	17

Spring Semester

30-306 Introduction to Gerontology	3
31-211 Intro. to Health Education	3
35-252 Physiological Sciences II	3
35-254 Physiological Sciences II Lab.	1
47-163 The Human Life Span	3
82-351 Human Sexuality	3
Elective (Area III)	3
	19

Junior Year

Fall Semester

01-391 Philosophy of Education or	
01-392 Phil. & Moral Issues in Education	3
30-303 Nutrition & Physical Fitness	3
31-301 Environ. & Consumer Health	3
31-306 Curriculum & Methods of Teaching Health Education I	3
47-328 Dynamics of Interpersonal Relations	3
Literature Elective	3
	18

Spring Semester

01-371 Educational Psychology	3
01-384 Educational & Cultural Diversity	3
31-304 Drug, Alcohol & Smoking Ed.	3
31-307 Curriculum & Methods of Teaching Health Education II	3
Elective	3
	15

Senior Year		Spring Semester	
Fall Semester			
30-302 Safety Education	3	* 31-404 Apprentice Teaching of Health -	
31-401 Mental Health Education & Health Counseling	3	Secondary Schools & Seminar	12
* 31-403 Community Health Education Practicum	9		12
	15		

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*If the student has a special request for a field placement in the Community or Student Teaching Practicum, the request must be in by:

April 15th for the Community Practicum

November 15 for the Student Teaching Practicum

No student will be allowed to participate in an internship until all prerequisite courses have been completed. The ultimate decision regarding field assignments rests solely with the faculty of the department.

Health Services Administration Major

The major in health services administration is offered in cooperation with the College of Management Science and prepares students for entry-level management positions in health facilities and agencies such as hospitals, nursing homes, boards of health, community health centers, mental health centers, and other community health agencies. The health services administration program is a member of the Association of University Programs in Health Administration (AUPHA). This program will be offered until May of 1985.

The health services administration program is based on both academic and practical competencies. Health services administration develops and refines its specific foundations of knowledge and uses these to continually expand both theory and practice.

As practitioners in a scientific discipline, the health services administrator works with other health professionals to create holistic service modalities, assisting individuals, groups and communities to meet health needs. Health services administrators are self-directed, decision-making, goal-oriented practitioners and must be able to use knowledge from the fields of management, law, clinical sciences, behavioral sciences, computer sciences, statistics and research methods.

The program in health services administration will prepare competent, entry-level professionals practicing in a variety of settings, who have a foundation for continued personal and professional growth and development.

An important component of the major in health services administration is administrative internships in the senior year. Students spend two days a week in their internship fall semester and three days a week spring semester under the supervision of field preceptors and university faculty. No student will be allowed to participate in an internship until all prerequisite courses have been completed. The ultimate decision regarding field assignments rests solely with the faculty of the Department.

Students who wish to take the examination for licensure as a nursing home administrator will be required to do a two-semester internship in a long-term care facility and to participate in review classes for the examination. The requirement for a fall semester internship in a nursing home may be waived at the discretion of the faculty if the student has previous health care experience. The faculty of the Department of Health will certify for examination only those students who have satisfactorily completed department requirements.

The recipient of the Bachelor of Science in Health Services administration will be expected to:

Utilize a broad-based body of knowledge encompassing the biological and social sciences to promote the optimal health of the individual;

Identify the major interrelated components, elements and issues which affect the organization and delivery of contemporary health care services in a changing environment;

Describe the relationship of sociocultural, ethical and moral influences on the behavior of health care consumers, professionals, providers and governmental agencies;

Apply knowledge of the legal, fiscal, legislative and environmental factors influencing health care and its delivery;

Apply administrative and management principles and techniques as they relate to goal setting, planning, implementation, and evaluation within the organizational structures of health care;

Exhibit entry-level skills in administration and management practice including human relations and communication abilities;

Recognize the need for continued personal and professional growth;

Fulfill the University of Lowell and departmental criteria for full completion of the academic and clinical program in health services administration.

Retention, Continuance and Appeals Procedure

To qualify for continued matriculation in the health services administration program, all students must meet the academic criteria as specified in the retention and continuance policies for the College of Health Professions.

COURSE OF STUDY FOR HEALTH SERVICES ADMINISTRATION

Freshman Year

Fall Semester

30-101	Introduction to Health Prof.	2
35-101	Anatomy & Physiology I	3
35-103	Anatomy & Physiology Lab I	1
39-	Physical Education	1
42-101	College Writing	3
47-	Psychology Elective	3
48-	Sociology Elective	3
		16

Spring Semester

30-201	Community Health	3
35-102	Anatomy & Physiology II	3
35-104	Anatomy & Physio. Lab II	1
39-	Physical Education	1
42-102	College Writing & Lit.	3
	Elective (Area II)	3
	Elective	3
		17

Sophomore Year

Fall Semester

31-303	Contemporary Health Prob.	3
35-211	Basic Clinical Microbiology & Pathology	3
35-213	Cl. Micro. & Path. Lab.	1
35-251	Physiological Science I	3
35-253	Physiological Science I Lab	1
60-201	Accounting Principles I	3
	Elective (Area II)	3
		17

Spring Semester

30-306	Introduction To Gerontology	3
35-252	Physiological Science II	3
35-254	Physiological Science II Lab	1
60-202	Accounting Principles II	3
64-202	Economics II	3
92-209	Intro. to Computer Programming	3
		16

Junior Year

Fall Semester

32-311	Long Term Care	3
32-315	Health Care Finance I	3
48-351	Sociology of Health	3
92-383	Introduction to Statistics	3
92-	Computer Elective	3
		15

Spring Semester

32-316	Health Care Finance II	3
32-422	Health Planning & Policy	3
47-328	Dynamics of Interpersonal Relations	3
66-253	Organizational Behavior	3
	Elective (Major Area)	3
	Elective	3
		18

Senior Year

Fall Semester

32-409	Administrative Internship in H.S.A. I	6
32-411	Health Law & Regulation	3
32-415	Administrative Seminar in H.S.A. I	3
31-401	Mental Health Education and Health Counseling	3
		15

(taken in place of 32-417)

Spring Semester

32-410	Administrative Internship Seminar in H.S.A. II	9
32-418	Administrative Seminar in H.S.A. II	3
32-454	Program Development Management & Evaluation	3
		15

Health Education (Course Prefix: 31)

31-211 INTRODUCTION TO HEALTH EDUCATION

I(3,0)3

This course focuses on the role that health education plays in the development of healthful patterns of living. Negative societal influences on behavior are discussed. A philosophy of health education will be developed to serve as a base for the curriculum in health.

31-301 ENVIRONMENTAL AND CONSUMER HEALTH

I(3,0)3

Environmental health develops the concept that the existence of man will depend on his ability to interact effectively with the total environment and focuses upon the effect of environment on the individual's health. Consumer health assists in the process of discriminating between reliable and unreliable health information and advertising and assists the consumer in choosing health services wisely.

31-302 SAFETY EDUCATION**I(3,0)3**

This course focuses on the personal community, industrial and environmental aspects of safe living behavior and safety education as well as the resources and agencies that are directly concerned with the varied facets of first aid and safety delivery education.

31-303 CONTEMPORARY HEALTH PROBLEMS**I or II(3,0)3**

This course focuses on the major contemporary health problems and diseases that afflict people throughout the life cycle. The physical, mental and social etiology of disease is stressed with great emphasis in the area of prevention.

31-304 DRUG, ALCOHOL AND SMOKING EDUCATION**II(3,0)3**

This course focuses on the varied aspects of drug use/misuse; physiological and psychological impact, enforcement problems relative to violation of drug laws, rehabilitation programs in the area of drug addiction and problems, social and economic implications, personal, community and social responsibilities and various educational programs and approaches.

31-306/307 CURRICULUM AND METHODS OF TEACHING HEALTH EDUCATION**I, II(3,0)3**

Curriculum and methods of teaching Health Education develops an understanding of the major teaching and research methodologies in health education. Writing of a variable Health education Curriculum and lesson plans will be stressed and familiarity with different teaching techniques will be developed. Measurement and evaluation of learning outcomes will be covered. Problems in reading which inhibit learning and possible remedies will be identified and discussed. Prerequisite: 31-211

31-401 MENTAL HEALTH EDUCATION AND HEALTH COUNSELLING**I(3,0)3**

This course stresses the idea that one's feelings about the self are the basic determinant of mental health. A positive model of mental health is developed and techniques of dealing with life stresses are discussed with the objective of implementing these concepts in the school health curriculum. Health counseling develops an understanding of the theory and practice of counseling.

31-403 COMMUNITY HEALTH EDUCATION PRACTICUM**I APR)9**

This course offers the health education student an opportunity to function as a health educator in a community agency involved in some dimension of health education. Community placements are arranged by a Department of Health Supervisor. The student spends twelve hours per week working in the agency for the entire semester. Prerequisite: Completion of all freshman, sophomore and junior courses. Seniors only.

31-404 APPRENTICE TEACHING OF HEALTH IN SECONDARY SCHOOLS**II(APR)12**

This course meets the apprentice teaching requirements for teacher certification set by the State Department of Education. The student spends the entire semester in a local public school. Placement is arranged by university faculty supervisors. Prerequisite: Completion of all freshman, sophomore and junior courses. Seniors only.

Health Services Administration (Course Prefix: 32)

32-311 LONG TERM CARE**I(3,0)3**

This course is a basic orientation to the field of long-term care. Administrative alternatives to institutionalization of the chronically ill and aged are presented.

32-315 HEALTH CARE FINANCE I**I(3,0)3**

This course will provide the student with an understanding of the principles by which health care is financed and the mechanism of fiscal control in the United States. This course will focus on the macro level of health care financing, and will emphasize understanding of third-party reimbursement, government regulations and requirements of regulatory, reimbursement and governmental agencies.

32-316 HEALTH CARE FINANCE II**II(3,0)3**

This course will provide the knowledge of health care finance which the student needs to be a health services administrator in a nursing home, hospital, other health facility or non-institutional health services organization. It will stress fiscal management and the requirements of regulatory, reimbursement and governmental agencies.

32-401 ADMINISTRATIVE INTERNSHIP I**I(2,12)6**

Administrative Internship I provides students with opportunities to observe the application of basic theory to administrative practice in a health care organization. Health Services Administration faculty and specified agency

personnel will supervise students in the attainment of identified objectives. Prerequisite: Completion of all freshman, sophomore and junior courses. Seniors only.

32-410 ADMINISTRATIVE INTERNSHIP II II(2,12)6

Administrative Internship II provides students with the opportunity to practice administrative skills and to observe qualified Health Services Administrators. An individual student project will be completed. Health Services Administration faculty and specified agency personnel will supervise students in the attainment of identified objectives. Prerequisite: Completion of all freshman, sophomore, and junior courses. Seniors only.

32-411 HEALTH LAW AND REGULATIONS I(3,0)3

This course provides the students with a study of laws and the subsequent regulations that affect health care and the delivery of health care.

32-415 SEMINAR IN HEALTH SERVICES ADMINISTRATION I I(3,0)3

This seminar will provide students with an understanding of the theory and practice of Health Services Administration and an opportunity to explore the component processes of the management of Health Services. Students will be required to apply the experiences of their internships and the literature of Health Services Administration to seminar discussion and to problems and case studies emphasizing analytical, evaluative and decision-making skills. This seminar taken with Internship Administrative Internship I.

32-418 SEMINAR IN HEALTH SERVICES ADMINISTRATION II II(3,0)3

Case studies will be used to give students practice in decision making. There will be considerable emphasis on the administrator's relationship with others in the health care system and with those outside the health care system whose activities impinge upon the administrator's. Students will be expected to use their internship experience in the seminar. This seminar taken with Internship Administrative Internship II.

32-422 HEALTH PLANNING AND POLICY II(3,0)3

Focuses on the theory and practice of health planning, organization and operation of contemporary structures for health planning and modes of involvement of components of the health industry and the public. Implication of P.L. 93-461 are stressed in this course. Provides the insights and background necessary for competent participation and linkages in the health planning process.

32-454 PROGRAM DEVELOPMENT, MANAGEMENT AND EVALUATION II(3,0)3

This course offers current relevant information and guidance in the development, management and evaluation of health and human services in the community.

DEPARTMENT OF PHYSICAL THERAPY

Joseph A. Dorsey, Chairperson

Professor: Joseph A. Dorsey

Assistant Professors: Barbara Cocanour, Alison Holness, Linda Kahn, Elizabeth Potter

Instructors: Merry Lynn Hamilton, Nancy Peatman

Physical Therapy Major

The physical therapist works with medical personnel and community health organizations in contributing to programs of patient care and management the general aims of which are the prevention and alleviation of bodily dysfunctions or deformity. The therapist may serve in hospitals, industry, community health agencies, rehabilitation centers, or may maintain a private practice. Individuals who are interested in scientific and medical fields, and who enjoy working closely with people of all ages, will find physical therapy a career which is rewarding and fulfilling. The physical therapy program is fully accredited by the American Physical Therapy Association.

The faculty of the program in physical therapy believes that individuals have intrinsic values and must have the opportunity to interact effectively in a changing environment. In order to be contributing members of society, people have the right to optimal health throughout their lifespan. Physical, biological, psychological or social imbalances may cause an individual to cease effective functioning. Physical therapy is considered integral to the prevention of illness caused by these imbalances as well as for the maintenance or rehabilitation of individuals to their optimal level of physiological functioning.

To meet the physical therapy needs of society, practitioners must be prepared in an academic program which emphasizes the integration of the theoretical bases with the psychomotor skills using a problem-solving* approach to practice. The graduates must comprehend the synthesis of the physiological, cognitive, and affective dimensions that are integral to effective functioning of the whole person. The physical therapy graduate is a clinician who uses teaching, management, consulting, and research skills and is able to provide services to the whole person through the interdisciplinary team approach. The goal of the physical therapy program is to prepare competent, entry-level, professional practitioners who have a foundation for continuing professional development and who acknowledge and develop the skills necessary to practice. Graduates are prepared to practice as physical therapists in a variety of settings including hospitals, rehabilitation centers, schools, extended care facilities, industry, community health, and private practice.

The faculty believes that students are active participants in the educational process. As potential professionals, the relationship between students and faculty should be one in which there is mutual respect, understanding, and interchange of ideas. Faculty, as experienced professionals, are resource persons, counselors, facilitators, motivators, and role models for the potential professional.

*Problem-solving: The ability to gather data and from this to either identify a problem or to clarify a given problem; to formulate comprehensive and appropriate goals relating to this problem utilizing a combination of professional and psycho-social knowledge; to delineate a variety of possible solutions for each goal and to abstract and implement that which is most appropriate for the current situation.

The graduate of the program in physical therapy at the University of Lowell will be prepared to:

- Practice physical therapy in a safe, ethical and legal manner;
- Promote the prevention of disease, deformity or injury through the practice of physical therapy;
- Utilize a perspective which combines both the physical and the psycho-social aspects of health care;
- Interact and communicate effectively with others;
- Incorporate the affective dimension in the evaluation and treatments of clients through the use of the empathic process;
- Evaluate the physical therapy needs of individuals of all ages using the problem-solving approach;
- Design and implement an individualized physical therapy plan of care based on identified needs using the problem-solving approach;
- Integrate teaching and learning principles in all facets of physical therapy practice;
- Evaluate and use professional research and literature in the delivery of physical therapy services;
- Assume responsibility for continuing professional development;
- Organize and develop a physical therapy service in a variety of agencies;
- Participate in change within the health care delivery systems to assure quality health care.

Clinical Affiliations

Clinical affiliations are integrated from the second semester sophomore year throughout the upper division physical therapy courses. Full time affiliations are scheduled in the summer of the junior year and the spring semester of the senior year. The clinical aspects of the physical therapy program are developed, coordinated, and supervised by the physical therapy faculty and are provided in collaboration with health agencies and hospitals throughout New England. Physical therapy students are responsible for all transportation, housing costs and meals related to affiliations and students should expect to be placed outside of the local university area for one or all affiliations.

Required Uniforms

At the beginning of their affiliations, students are required to purchase uniforms consisting of navy blue trousers, white lab coats, and white or black hospital shoes, name tags and insignia. All of these requirements may be purchased at the South Campus Bookstore.

Retention, Continuance, Grading Policies and Appeals Procedure

The retention, continuance, and grading policies for Physical Therapy majors will follow these policies as specified in the retention and continuance policies in the College programs. In addition, the clinical affiliations are graded on an "S" (satisfactory) or "U" (unsatisfactory) basis. A grade of "S" indicates that a student has satisfactorily completed the course objectives for the clinical experience. A grade of "U" indicates that a student was unable to meet the course objectives and will be immediately dropped from the program. Such students may seek reinstatement to the program through the appeals procedure.

Any student who has been denied continuance in the physical therapy major for academic reasons, or any student who has been dropped from the program for non-academic reasons may appeal for reinstatement. The appeals procedure for reinstatement is outlined in the policies of the College of Health Professions.

Transfer Policies for Physical Therapy

The program in physical therapy does not accept transfers directly into the program because of the numbers of students desiring entrance into the program. Students who wish to transfer must first be accepted to the University and then compete academically for positions as they become available in the physical therapy program. Those students who are drawn from the waiting list should be aware that acceptance into the program is dependent upon successful completion of all prerequisite courses. Transfer students that are accepted are placed in the freshman and sophomore class at the end of each semester.

COURSE OF STUDY FOR PHYSICAL THERAPY (Classes of 1983, 1984, 1985).

Freshman Year

Fall Semester

35-101	Anatomy & Physiology I	3
35-105	Anatomy & Physiology I Lab	3
39	Physical Education	1
42-101	College Writing	3
47-101	General Psychology	3
47-163	Human Lifespan	3
	Elective	3
		17

Spring Semester

30-201	Community Health	3
35-102	Anatomy & Physiology II	3
35-106	Anatomy & Physiology II Lab	1
39-	Physical Education	1
42-102	College Writing and Literature	3
92-383	Intro. to Statistics	3
48-101	Intro. to Sociology	3
		17

Sophomore Year

Fall Semester

35-251	Physiological Chemistry I	3
35-253	Physiological Chemistry I Lab	1
	Elective (area II)	3
47-275	Psychology of the Handicapped	3
47-328	Dynamics of Interp. Relationship	3
95-104	General Physics I	3
96-103	General Physics I Lab	1
		17

Spring Semester

01-371	Educational Psychology	3
34-200	P.T. Prin. & Practice I	3
34-202	P.T. Prin. & Practice I Lab/Clinic	1
35-252	Physiological Chemistry II	3
35-254	Physiological Chemistry II Lab	1
95-104	General Physics II	3
96-104	General Physics II Lab	1
	Elective	3
		18

Junior Year

Fall Semester

34-301	Advanced Anatomy	3
34-303	Advanced Anatomy Lab	1
34-305	Exercise Physiology	3
34-307	Exercise Physiology Lab	1
34-309	P.T. Prin. & Practice II	3
34-311	P.T. Prin. & Practice II Lab/Clinic	1
34-313	Med. Surg. Conditions I	3
34-315	Kinesiology	3
		18

Spring Semester

34-302	Functional Neuroanatomy & Neurophysiology	4
34-304	Functional Neuroanatomy & Neurophysiology Lab	1
34-310	P.T. Prin. & Practice III	3
34-312	P.T. Prin. & Practice III Lab/Clinic	1
34-314	Med. Surg. Conditions II	3
35-356	Pharmacology	2
	Elective (area II)	3
		17

Summer

Session I

34-317	P.T. Prin. & Practice IV	3
34-319	P.T. Prin. & Practice IV Lab/Clinic	1
		4

Session II

34-316	Physical Therapy Clinical Education I	4
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Senior Year

Fall Semester

34-401 Management in Physical Therapy	3
34-403 P.T. Prin. & Practice V	6
34-405 P.T. Prin. & Practice V Lab/Clin.	2
34-407 Research in Physical Therapy	3

14

Spring Semester

34-402 Physical Therapy Clinical Education II	12
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12

Physical Therapy (Course Prefix: 34)

34-200 PHYSICAL THERAPY PRINCIPLES & PRACTICE I

II(3,0)

This course is the first in a series of five courses dealing with the practice of physical therapy. The course introduces the student to the history, the ethics and the terminology used in the profession. The course also introduces the students to the underlying theory of basic physical agents and massage. Architectural barriers as they relate to patient functioning is also introduced. Prerequisites: 35-102, 35-104, 35-251, 35-253, 95-103, 96-103, 47-275. Corequisites: 35-252, 25-254, 95-104, 34-202, 47-328, 96-104

34-202 PHYSICAL THERAPY PRINCIPLES & PRACTICE I LAB/CLINIC

II(3,0)1

This course is a laboratory course taken concurrently with 34-200. It offers the students an opportunity to practice, demonstrate and test theories in the school laboratory. Students are also taught the techniques of patient transport and ambulation. One laboratory session every month will take place in local physical therapy departments to practice skills. Prerequisites: 35-103, 35-104, 35-351, 35-253, 95-102, 96-103. Corequisites: 35-252, 35-254, 95-104, 96-104, 34-200.

34-301 ADVANCED ANATOMY

I(3,0)3

Advanced anatomy is a study of the structures of the human body, utilizing lectures, demonstrations and A.V. materials. Prerequisites: 35-102, 35-104, 34-200, 34-202. Corequisites: 35-252, 35-254, 95-104, 96-104.

34-302 FUNCTIONAL NEUROANATOMY & NEUROPHYSIOLOGY

II(4,0)4

Functional neuroanatomy and neurophysiology presents the structural and functional features of the nervous system as they relate to problems encountered in clinical neurology. Prerequisites: 34-301, 34-303.

34-303 ADVANCED ANATOMY LABORATORY

I(0,3)1

Advanced anatomy laboratory is the study of the structures of the human body through the laboratory dissection of prosected parts and human cadavers. This course runs concurrently with 34-301. Prerequisites: 35-103, 35-104, 34-200, 34-202. Corequisites: 35-252, 35-254, 95-104, 96-104.

34-304 FUNCTIONAL NEUROANATOMY & NEUROPHYSIOLOGY LAB

II(0,3)1

Functional neuroanatomy and neurophysiology lab is a visualization of the structures of the human brain, spinal cord and peripheral nervous system utilizing dissection and A.V. resources. Prerequisites: 34-301, 34-303.

34-305 EXERCISE PHYSIOLOGY

I(3,0)3

This course is a study of the effects of exercise on the human organism. The course involves using bicycle ergometry, treadmill running and other exercise regimes in test situations. Students practice the essentials of cardiorespiratory monitoring and respiratory gas analysis in evaluating physiological changes. Exercise is an integral part of the course. Students are therefore, required to present evidence of a current physical exam indicating their health status. Prerequisites: 35-102, 35-104, 35-252, 35-254. Corequisites: 34-200, 34-202.

34-307 EXERCISE PHYSIOLOGY LABORATORY

I(0,3)1

This course is a laboratory course taken concurrently with 34-305. It offers students the opportunity to test theories and to practice and demonstrate skills developed in 34-305. Prerequisites: 35-101, 35-102, 35-103, 35-104. Corequisites: 35-251, 35-252, 35-253, 35-254, 34-200.

34-309 PHYSICAL THERAPY PRINCIPLES & PRACTICE II

I(3,0)3

The topics to be covered in this course includes physical therapy evaluation methods and treatment procedures for medical-surgical conditions of the skin, trunk and back, the cardiovascular system, and the respiratory system. The general principles of spinal orthotic fabrication and use are presented and applied to specific physical therapy problems. Prerequisite: 34-202. Corequisite: 34-311.

34-310 PHYSICAL THERAPY PRINCIPLES & PRACTICE III

II(3,0)3

This course focuses on evaluation methods and treatment procedures for the upper and lower extremities, head

and neck, and evaluation and remediation techniques for gait abnormalities. The general principles of orthotic and prosthetic fabrication and use are presented and applied to specific physical therapy problems. Prerequisites: 34-200, 34-309. Corequisite: 34-312.

34-311 PHYSICAL THERAPY PRINCIPLES & PRACTICE II LAB/CLINIC II(0,3)1

Practical application of evaluation techniques and treatment procedures addressed in 34-309 will be emphasized in this course. Topics covered include evaluation and treatment procedures for medical-surgical conditions of the skin, trunk and back, the cardiovascular system and the respiratory system. One lab session every month will be held in local physical therapy departments to practice the skills learned in the laboratory. Prerequisite: 34-202. Corequisites: 34-309.

34-312 PHYSICAL THERAPY PRINCIPLES & PRACTICE III LAB/CLINIC II(0,3)1

The practical application of evaluation techniques and treatment procedures addressed in 34-310 will be emphasized in this course. Topics covered include evaluation and treatment procedures for the upper and lower extremities and evaluation and remediation techniques for gait abnormalities. The general principles of orthotic and prosthetic use and gait deviations are examined. One lab session each month will be held in local physical therapy departments to practice the skills taught in the laboratory. Prerequisites: 34-200, 34-309. Corequisite: 34-310.

34-313 MEDICAL SURGICAL CONDITIONS I I(3,0)3

The first part of a two-semester course dealing with medical, surgical, orthopedic and neurological conditions commonly encountered in patients treated by the physical therapist. Emphasis is placed upon the causes of these diseases and the indications for various treatment procedures. Prerequisites: 35-102, 35-104, 35-252, 35-254, 34-200, 34-202. Corequisites: 34-301, 34-303, 34-305, 34-307, 34-309, 34-311, 34-315.

34-314 MEDICAL SURGICAL CONDITIONS II II(3,0)3

This course is a continuation of 34-313 dealing with medical, surgical, orthopedic and neurological conditions commonly encountered in patients treated by the physical therapist. Emphasis is placed upon the causes of these diseases and the indications for various treatment procedures. Prerequisites: 35-102, 35-104, 35-252, 35-254, 34-200, 34-202, 34-313. Corequisites: 34-302, 34-304, 34-310, 34-312, 35-356.

34-315 KINESIOLOGY I(3,0)3

This course deals with the mechanics of human motion with emphasis on body mechanics and those deviations from sound mechanical principles which effect it. The course also introduces the student to the techniques used by physical therapists to analyze human motion. Prerequisites: 35-102, 35-104, 35-252, 35-254, 95-103, 95-104, 96-103, 96-104, 34-200, 34-202.

34-316 PHYSICAL THERAPY CLINICAL EDUCATION I SII(0,40)4

Students enrolled in this course are placed in affiliated hospitals, rehabilitation centers or extended care facilities for a full time six-week rotation. Learning experiences are provided for the student to apply the theory gained in lecture and further develop their psychomotor skills acquired in the school laboratory. Students are directly supervised by clinical instructors at each facility. This required course for beginning seniors is offered during second summer session prior to the senior year. Prerequisites: A. All course work up to and including the junior year; B. Students are required to have evidence of liability and medical coverage (available through the University); C. Students must have health evaluation form completed by a physician.

34-317 PHYSICAL THERAPY PRINCIPLES & PRACTICE IV SI(3,0)3

This course deals with the theory and application of advanced procedures utilized by physical therapists for evaluation and treatment. Topics covered include: electro-diagnosis, electro-myography, therapeutic electrical current, functional electrical stimulation, iontophoresis, transcutaneous electrical nerve stimulation (TENS) and biofeedback. Prerequisites: 34-200, 34-202, 35-317, 34-310, 34-312, 34-309.

34-319 PHYSICAL THERAPY PRINCIPLES & PRACTICE IV LAB SI(0,3)1

Practical application of procedures covered in 34-317. Topics covered include electro-diagnosis, therapeutic electrical current, transcutaneous electrical nerve stimulation (TENS) and EMG biofeedback.

34-401 MANAGEMENT IN PHYSICAL THERAPY I(3,0)3

This course is an overview of the operation/functional role of the physical therapy department within the total organizational structure of the health care system. Emphasis will also be placed on the ethical, legal and professional issues pertinent to physical therapists. Students will be given the opportunity to develop basic administrative skills through lectures, reading assignments, class participation and individual and group projects.

34-402 PHYSICAL THERAPY CLINICAL EDUCATION II

11(0,40)12

Students apply the cumulative knowledge and skills gained in lecture and laboratory/clinic courses during two full time 8-week rotations at affiliated hospitals, rehabilitation centers, home care agencies, pediatric facilities or private practices. This course is the final clinical component of the students' physical therapy education and occurs during the spring semester of the senior year. Prerequisites: A. All Physical therapy courses; B. Students are required to have evidence of liability and medical coverage (available through the University); C. Students must have health form completed by physician.

34-403 PHYSICAL THERAPY PRINCIPLES & PRACTICE V

I(6,0)6

This course emphasizes the theory and application of advanced therapeutic procedures and special techniques used by physical therapists for evaluation and treatment. Topics covered include: spinal cord rehabilitation, normal and abnormal sensorimotor development, neurodevelopmental evaluation and treatment, proprioceptive neuromuscular facilitation (PNF), the specialized approach of Brunnstrom, Rood, and Bobath, isokinetics, cyriax evaluation and treatment, prenatal and postpartum physical therapy and joint mobilization. Prerequisites: 34-200, 34-309, 34-310, 34-317.

34-405 PHYSICAL THERAPY PRINCIPLES & PRACTICE V LAB/CLINIC

I(0,6)2

This course runs concurrently with 34-403 and emphasizes the practical application of theory and techniques addressed in the lecture section. Topics covered include: spinal cord rehabilitation, neurodevelopmental evaluation and treatment, PNF, the specialized approach of Brunnstrom, Rood, and Bobath, isokinetics, cyriax evaluation and treatment, prenatal and postpartum programs and joint mobilization. Students practice in laboratory and clinic settings. Prerequisites: 34-200, 24-309, 34-310, concurrent enrollment in 34-403.

34-407 RESEARCH IN PHYSICAL THERAPY

I(3,0)3

This course is designed to give an overview of the type of research currently being used in the area of physical therapy. Emphasis will be placed on the development of the research proposal, selection of appropriate experimental design, statistical analysis of results and the ability to critique existing research publications. Students will be required to develop each component of a research proposal including possible sources of funding.

DEPARTMENT OF NURSING

May Futrell, Chairperson

Professors: May Futrell, Elizabeth Mullett, Marilyn Rawsley, Eleanor Forsley Shalhoup

Associate Professors: Louise Rauckhorst, Janice Stecchi

Assistant Professors: Carolyn Cochrane, Marian Dubrule, Joan Lewis, Anna Omerly, Grace Sullivan, Eileen Williamson.

Instructors: Louise Battista, Barbara Dalton, Susan Haussler, Beverley Johnson, Diane Mahoney, Sarah Moroney, Linda Svetz

Skills Coordinator: Elizabeth Tavoularis

The Department of Nursing offers majors in nursing leading to the degrees of Bachelor of Science and Master of Science. For information concerning the masters program, see the Graduate School Catalogue.

Nursing Major

The nursing program prepares a professional nurse who is a competent, beginning practitioner and has a foundation for graduate study. The goal of the undergraduate program in nursing at the University of Lowell is to prepare professional nurses who have the ability to think logically, to utilize knowledge of relevant theories, and to apply the nursing process with individuals and groups.

Graduates of the nursing program are prepared to function in a variety of settings, such as hospitals, visiting nurse associations, and nursing homes. They are eligible to sit for the Board of Registration in Nursing examination for licensure as a Registered Nurse.

The nursing program is approved by the Massachusetts Board of Registration in Nursing and is fully accredited by the National League for Nursing.

The Faculty of the Department of Nursing believes that Man is a unique, rational being who has needs for safety and security, love and belonging, esteem and self-actualization, and who interacts purposefully in a changing

environment. Man is perceived as a continually developing individual possessing innate rights and the ability to make choices to establish goals which determine his future. Fundamental to these rights is the right to attain optimal health. Nursing assists the individual to attain this level of health by facilitating adaptation that allows him to function at his developmental level within his social system.

Nursing, as a learned profession, is both an academic and a practice oriented discipline. As an academic discipline, nursing is developing and refining its substantive and practical knowledge base through continuing scientific inquiry into its theory and its practice. Nursing Science builds its body of knowledge through analysis of existing theories, leading to the syntheses of new conceptual relationships that can be operationalized in professional nursing practice. Nursing will have a strong role in determining health policy and practice in the future.

As members of a practice-oriented discipline, professional nurses interact in collaborative relationships with other health professionals to formulate a holistic approach when assisting individuals, groups, and communities to meet health needs. The cognitive, affective, and psychomotor competencies of the professional nurse are integrated and demonstrated in assessing, planning, implementing, and evaluating direct and indirect care of clients. Practitioners of professional nursing accept the rights and responsibilities of self-direction for nursing judgements and decision-making in order to facilitate the optimum well-being of their clients on the health illness continuum. Inherent in these professional responsibilities are the leadership skills of accountability, advocacy, delegation, and supervision. As a service to man and society, nursing, through use of the nursing process, carries out professional nursing activities to assist the individual, the family, and the community in the pursuit of well-being.

The emerging role of the professional nurse will emphasize primary care and prevention in traditional and innovative health care settings to assist man in attaining his optimal level of health. This role is acknowledged as one which prepares the nurse to accept new responsibilities and to design and implement new approaches to delivery of health care.

The Faculty believes that education is a self-actualizing, creative lifetime endeavor which involves values clarification, progressive inquiry, and critical analysis and judgement. Baccalaureate nursing education incorporates liberal education with generalized preparation in professional nursing.

Support of the individual's growth and self-evaluation during the program enables the student to develop his/her own professional philosophy which will be refined throughout his/her career.

The faculty believes that graduate level education in nursing focuses on specialization, research, and leadership preparation. Specialization includes both a clinical focus and a functional focus. Advanced education is achieved through the synthesis of specialized knowledge, applied theory, and expanded skills.

Upon successful completion of the University of Lowell undergraduate program in nursing, the graduate is prepared as a generalist for beginning professional nursing roles. Specifically, the Faculty believes that the graduate is prepared to:

- Demonstrate, through relationships with others, recognition of intrinsic worth, responsibilities, and rights of self and others;
- Establish, maintain, and terminate therapeutic relationships with individuals and groups;
- Utilize the nursing process to make critical judgements when caring for people of all ages in any setting;
- Integrate relevant principles and theories from the behavioral sciences, natural sciences, and the humanities into the practice of professional nursing;
- Contribute to the optimal health of individuals, families, and groups by providing safe, competent, professional nursing care independently and in collaboration with others;
- Integrate teaching/learning concepts into nursing practice to promote health;
- Assume leadership responsibilities to effect change for the improvement of nursing care;
- Appreciate the historical perspective of the profession of nursing and the relationship to contemporary and future nursing roles;
- Contribute to the expanding body of nursing knowledge through application of research findings and/or the participation in research;
- Accept responsibility for continuous growth as a person, a professional practitioner, and a contributing citizen in society.

Clinical Laboratory Placements

Major courses in nursing are offered within the Department of Nursing and are under the direct control and supervision of the faculty of nursing. The clinical aspects of the nursing program are developed, coordinated, and supervised by the nursing faculty and are provided in collaboration with members of the community agencies utilized. Placements include: Bon Secours Hospital, D'Youville Manor, Lowell General Hospital, Lowell Housing Authority, Lowell Visiting Nurse Association, Nursery Schools, Prescott House Nursing Home, St. John's Hospital, St. Joseph's Hospital, University of Mass. Medical Center, Palm Manor Nursing Home, Veteran's Administration Hospital-Bedford, and Willow Manor Nursing Home. Additional agencies are utilized when necessary to enhance students' learning.

Required Uniforms

In order to participate in the clinical portion of the curriculum, each nursing student is required to purchase an official uniform, insignia, appropriate shoes, a name pin, bandage scissors, and a watch with a second hand. Female nursing students also must purchase a cap and either a blue pin-stripe laboratory coat or a navy-blue pants suit for community learning experiences. Male nursing students also must purchase for the community learning experience a blue shirt and blue pants. R.N. students have the option of wearing the University of Lowell student uniform and cap or their own uniform and cap. In any case, the R.N. must wear the University of Lowell student insignia and name pin. Uniform, cap, name pin, and insignia can be purchased at the South Campus Bookstore.

Transfer Policies for Registered Nurses

Registered Nurses who are graduates of diploma and associate degree nursing programs may be admitted to the nursing program and may be awarded advanced standing through a combination of transcript evaluation and course equivalency procedures. Students who may be interested in applying for credit through course equivalency procedures are referred to policies which appear elsewhere in this publication under the heading "Admission Policies: Advanced Placement with Course Credit". R.N. students may challenge five department-designated nursing courses (24 credits) by taking course examinations of the Department of Nursing. A grade of "BC" must be obtained in department equivalency examinations for equivalency credit to be recommended by the nursing faculty. Students who may be interested in applying for credit through this means are referred to policies which appear elsewhere in this publication under the heading "Academic Policies: Course Equivalency Examinations" and are advised to confer directly with the Department Chairperson.

The credentials of each R.N. applicant for credit will be considered individually on their own merits, but in no case may a student reduce the basic residency requirements of the University through any combination of transfer, advanced placement with credit, or course equivalency procedures. Students are referred to policies which appear elsewhere in this publication under the heading "Academic Policies: General Degree Requirements" for a discussion of residency requirements of the University.

For retention in the nursing program, the R.N. student must satisfy the same requirements as are met by the generic nursing majors.

Retention, Continuance, Grading Policies and Appeals Procedure

To qualify for continued matriculation in the nursing program, all students must meet the academic criteria as specified in the retention and continuance policies for the College of Health Professions (page 314).

In addition, the clinical portions of nursing courses are graded on a "S" (satisfactory) or "U" (unsatisfactory) basis. A grade of "S" indicates that a student has satisfactorily completed the course objectives for the clinical experience. Irrespective of his or her individual achievement in non-clinical course components, a student who receives an unsatisfactory clinical evaluation in a nursing course shall receive a final course grade of "F" (failure) and his or her enrollment shall be terminated immediately.

Any student who has been denied continuance in the nursing major for academic reasons or any student who has been dropped from the program for non-academic reasons may appeal for reinstatement. The appeal procedure for reinstatement is outlined in the policies of the College of Health Professions (page 317).

Withdrawal

Students who wish to withdraw from any nursing course are advised that such withdrawal requires simultaneous withdrawal from all nursing courses and termination of enrollment in the nursing program.

Such students who wish to apply for readmission to the Nursing program as members of subsequent graduation classes are advised that consideration for readmission is determined not only by academic eligibility requirements in effect for the class to which admission is sought but also by enrollment quotas. Accordingly, students are advised to confer with the Chairperson of the Department of Nursing prior to applying for readmission in order to ascertain if program vacancies exist.

COURSE OF STUDY FOR NURSING*

Freshman Year

Fall Semester

39-101 Physical Education	1
42-101 College Writing	3
47-101 General Psychology	3
Elective	3
84-111 General Chemistry I	4
	14

Spring Semester

35-201 Anatomy & Physiology	3
35-203 Anatomy & Physiology Lab I	1
42-102 College Writing & Literature	3
47-163 The Human Lifespan	3
48-101 Introduction to Sociology	3
84-112 General Chemistry II	4
	17

Sophomore Year

Fall Semester

35-202 Anatomy & Physiology II	3
35-204 Anatomy & Phys. Lab. II	1
35-211 Basic Clinical Micro. & Pathology	3
35-213 Basic Clinical Micro. & Pathology Lab.	1
92-383 Intro. to Statistics	3
47-232 Psych. of Personality	3
Elective	3
	17

Spring Semester

30-201 Community Health	3
33-201 Concepts for Prof. Nursing Practice	6
33-202 Pathophysiology	3
Elective (Area II)	3
45-202 Introduction to Logic	3
	18

Junior Year

Fall Semester

33-301 Dimensions of Professional Nursing Practice	2
33-302 Concepts Basic to Nursing Intervention	5
33-303 Nursing Care of Clients in Stress I	5
39-101 Physical Education	1
47-328 Dynamics of Interpersonal Relations	3
	16

Spring Semester

33-304 Nursing Care of Clients in Stress II	6
33-305 Nursing Care of Clients in Stress III	6
Elective (300 level)	3
	15

Senior Year

Fall Semester

33-401 Nursing Care of Clients in Crisis	12
Elective (300-400 level)	3
	15

Spring Semester

33-402 Issues and Trends in Nursing	2
33-403 Leadership in Nursing Practice	5
33-404 Comprehensive Nursing Practice	6
Elective	3
	16

*Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Curriculum Breakdown

University Core Requirements

College Writing-two courses

Area I Sociology

Psychology

Area II Introduction to Logic

Elective

Area III Chemistry

Statistics

Professional Nursing Courses

Additional Credits (include remaining prerequisites and electives)

Physical Education

Total Credits

6

3

9

3

3

8

3

58

33

2

128 Credits

Nursing (Course Prefix: 33)

33-201 CONCEPTS FOR PROFESSIONAL NURSING PRACTICE

II(3,6)6

This course introduces the student to concepts fundamental to the practice of nursing. Consideration is given to the process of adaptation, with emphasis on student adaptation to the professional nursing role. Theoretical as-

pects and practical application of the nursing process are viewed as the essential method of nursing science and nurse/patient interaction. Health assessment skills are taught and practiced in a laboratory setting. Basic nursing preceptual-motor skills are learned in a self-paced autotutorial laboratory setting. Prerequisite: First 3 semesters of nursing curriculum. Corequisite: 33-202. Members of the Department.

33-202 PATHOPHYSIOLOGY

II(3,0)3

This course is designed to present a conceptual approach to human pathophysiology. Content focuses on the basic mechanisms of disease processes and the resulting alterations in body function. Selected major health problems are studied as representative of the concepts of sensory deprivation, autoimmune response, fluid and electrolyte imbalance, oxygen deprivation, abnormal cell proliferation, chemical deregulation, and interference with nutrition and neural dysfunction. Corequisite: 33-201. Members of the Department.

33-301 DIMENSIONS OF PROFESSIONAL NURSING PRACTICE

I(2,0)2

This course is designed to increase the student's awareness of nursing as a dynamic evolving profession and to assist in the understanding of the role of a professional nurse. Emphasis is on the refinement of communication and interviewing techniques. Various levels of nursing practice are identified. The nurse as decision maker, teacher, advocate, and researcher is explored. Students are encouraged to analyze their own values as they relate to the values of the professions. Prerequisites: Completion of fourth semester nursing curriculum. Corequisites: 33-302, 303. Members of the Department.

33-302 CONCEPTS BASIC TO NURSING INTERVENTION

I A(4,12)5

The focus of this course is on the development and utilization of the nursing process in meeting the biopsychosocial needs of individuals at different stages of the life cycle. The role of the professional nurse in health promotion and health maintenance is emphasized. Application of the principles and theories underlying nursing is directed towards care of clients in long term facilities. Prerequisites: 33-201, 202. Corequisite: 33-301. Members of the Department.

33-303 NURSING CARE OF CLIENTS IN STRESS I

I B(4,12)5

The concepts of stress and adaptation and their relationships to health and level of wellness are considered from a cause and effect perspective. The developmental and situational stressors which influence the health of individuals and their families are explored. Theoretical class content is applied in a variety of clinical practice settings. Prerequisite: 33-302. Corequisite: 33-301. Members of the Department.

33-304 NURSING CARE OF CLIENTS IN STRESS II

II A(6,12)6

This course focuses on assessing man's spectrum of adaptive and maladaptive responses in short-term and long-term setting. Developmental and situational stressors are differentiated. Emphasis is placed on standards of professional practice, while planning and implementing nursing intervention that promote adaptive responses of individuals and families. Prerequisites: 33-301, 303. Members of the Department.

33-305 NURSING CARE OF CLIENTS IN STRESS III

II B(6,12)6

The course content focuses on the influence of stress and its effect on communication and health promotion. Clinical learning experiences provide the student with the opportunity to utilize the nursing process in caring for individuals and families experiencing difficulty in coping with stress. Prerequisite: 33-304. Members of the Department.

33-401 NURSING CARE OF CLIENTS IN CRISIS

I(5-14)12

Building upon previous knowledge of developmental and situational stressors, crisis is viewed from a theoretical perspective. The dynamics of crisis situations as they involve individuals, families and the community are analyzed. Clinical practice is planned to give students the opportunity to relate their experiences to appropriate theoretical models and to carry out therapeutic interventions appropriate to the care of clients at *risk to, or experiencing* crisis. Prerequisite: 33-305. Members of the Department.

33-402 ISSUES AND TRENDS IN NURSING

II(2,0)2

This course focuses on significant issues and trends resulting from societal developments. The impact of these issues and trends on professional nursing and health care is examined. Prerequisite: 33-401. Corequisite: 33-403, 404. Members of the Department.

33-403 LEADERSHIP IN NURSING PRACTICE

II A(4,12)5

The student's potential for directing, guiding and influencing others is developed in selected group experiences. Knowledge gained from theory, research, and experience is investigated and analyzed critically. The data are ap-

plied to the health care management of clients and families through the use of the nursing process, stressing client advocacy and interdisciplinary cooperation. The student will examine his/her own philosophy, learning needs, and growth, preparatory to becoming a more fully self-directed professional nurse.

33-404 COMPREHENSIVE NURSING PRACTICE

II B(0,24)6

This clinical course focuses on the transition to the professional nursing role. Planned clinical experiences are provided so that nursing skills can be refined and role behaviors and values internalized. Weekly conferences provide opportunities to share experiences and to evaluate progress in meeting objectives. Prerequisite: 33-403. Co-requisite: 33-402. Members of the Department.

DEPARTMENT OF PHYSICAL EDUCATION

Richard Aronson, Chairperson

Associate Professors: Richard Aronson, Claire Chamberlain, Denise Legault, A. James Oliver

Assistant Professors: Robert Callary, James Stone

Instructor: A. Grant Carrow

The Department of Physical Education administers the physical activities program which is required of all undergraduate students by the University Core Requirements. The Department also offers a minor area of study in coaching.

The physical education program of the University has as its general objective the development of basic motor skills which will enhance the productive use of leisure time. More specifically, the program seeks to improve individual health through increased organic vigor, to develop effective sports skills, to attain desirable standards of team conduct, and to promote lifetime interest in physical activity. In attaining these objectives, students are encouraged to select courses from both team and individual activities.

All students in the graduating classes of 1983-1986 must successfully complete one year of supervised physical activity in fulfillment of the University Core Requirements. Courses which satisfy the activities requirement are offered with the prefix number of "39." The Physical Activities Requirement for students in the graduating class of 1987 and following classes are under review and may be revised.

Theory Courses may be elected by students who are interested in receiving theoretical instruction concerning the coaching profession. These courses do not satisfy the requirements of the University Core concerning physical activities but may be counted for the Coaching minor. Theory courses are offered with a prefix number of "38".

Coaching Minor

A minor in coaching consists of 21 credits, 15 of which are specified core requirements.

Core Requirements

38-100 Care & Prevention of Athletic Injuries	3
38-210 Sport Psychology	3
38-321 Organization & Administration of Athletic Programs	3
38-322 Practicum in Athletics	3
38-420 Kinesiological & Physiological Aspects of Coaching*	3

*Anatomy & Physiology and Exercise Physiology may be substituted by permission of the Chairperson of the minor program.

Additional courses are selected from the offerings of the Department of Physical Education (38) or other courses in the College of Health Professions with the permission of the Chairperson of the Department of Physical Education.

Physical Education & Coaching (Course Prefix: 38)

The following courses may be taken as "unrestricted elective courses" by students who have a general interest in the theory and practice of physical education as well as by students who wish to pursue the minor of coaching. These courses do not satisfy the Physical Activities Requirement of the University Core Requirements.

- 38-100 CARE AND PREVENTION OF ATHLETIC INJURIES** I, II(3,0)3
The anatomy of all major types of athletic injuries, with emphasis on the nature and extent of injuries and the various modes of prevention and treatment.
- 38-210 SPORT PSYCHOLOGY** I, II(3,0)3
Provides students with a basic understanding of the psychological aspects of human behavior in relationship to competitive sports.
- 38-212 SPORTS IN AMERICA** I, II(3,0)3
A course designed to acquaint the student with the inherent values of sports as a social phenomenon.
- 38-321 ORGANIZATION AND ADMINISTRATION OF ATHLETIC PROGRAMS** I, II(3,0)3
The organization and administration of individual team and school athletic programs with emphasis upon developing skills in public relations and budgeting.
- 38-332 PRACTICUM IN ATHLETICS** I, II(3,0)3
Supervised coaching experience in a sports activity. The student will teach under the Guidance of a qualified coach, either at the University or other educational institution. (Upperclassmen only or permission of Chairperson)
- 38-324 SPORTS OFFICIATING** I, II(2,0)2
Seeks to develop officiating competencies, particularly in rules-interpretation and crowd-control.
- 38-420 KINESIOLOGICAL & PHYSIOLOGICAL ASPECTS OF COACHING** I,(3,0)3
A course designed to provide knowledge of body structure and movement for the purpose of analyzing human performance.
- 38-422 LEGAL ASPECTS OF ATHLETICS** II(3,0)3
Serves to develop concepts of physical welfare, safety, legal liabilities in the classroom, practice areas and contests.

Physical Activities (Course Prefix: 39)

The following courses, with a course prefix of 39, will satisfy the University's physical activities requirement for graduation but may not be credited to academic degree requirements.

- 39-100 BEGINNING ARCHERY** I A,B; II A(0,2)5
To introduce the beginning student to the skills in this highly individualized sport through proper technique and safety procedures. Shooting is done at both 20 and 30 yards in target archery.
- 39-102 BOWLING** I A,B; II A,B(0,2)5
Introduction to ten-pin bowling, the love of the sport, choice of equipment, basic bowling techniques, etiquette, scoring, and types of tournaments with competitive bowling. Extra \$1.65 fee for three strings, shoes and transportation to and from the lanes.
- 39-105 INTERMEDIATE ARCHERY** I B; II A,B(0,2)5
Time is spent to refine the seven basic stages of shooting with introduction to the use of ground markers, pin sights, and the fine points of shooting. (Prerequisite: 39-100 or permission of instructor).
- 39-109 FITNESS FOR WOMEN** I A,B; II A,B(0,2)5
To gain an overview of and to experience the various modes of conditioning principles in action through aerobics, XBX, circuit training, music, weight training, and the like. Discussions of anatomy and physiology plus that of nutrition and relaxation techniques to develop a critical approach to fitness as it applies to women.
- 39-110 FITNESS** I A; II B(0,2)5
To improve personal fitness levels through running, progressive flexibility exercises, calisthenics, and weight training.
- 39-112 BEGINNING GOLF** I A; II B(0,2)5
To introduce the beginning student to the basic grip, stance, swing, and etiquette of golf. Use of short, mid-, and long irons with a brief use of the woods.

- 39-113 INTERMEDIATE GOLF** II B(0,2)5
To improve the student's basic golf swing and choice of clubs in stroke strategy. Part of the time will be spent at a driving range and/or at a Par-3. (Prerequisite: 39-112 or permission of instructor.) Extra fee.
- 39-145 SOFTBALL** II B(0,2)5
Basic instruction in the skills involved in playing slow-pitch softball.
- 39-154 ELEMENTARY GAMES** I B; II A,B(0,2)5
To teach students how to teach games of low organization through increasing their leadership skills, group awareness, safety considerations, and how to deal with children. This course is especially good for future playground leaders, camp counselors, and Elementary Education majors.
- 39-155 VOLLEYBALL** I A,B; II A,B(0,2)5
To learn the techniques and skills used in power volleyball, its rules, etiquette, and team play. Emphasis will be placed on drills and competitive class play.
- 39-160 BEGINNING SWIMMING** I A,B(0,2)5
To equip the student with basic water safety skills and knowledge in order to make him/her reasonably safe while in, on, or about the water. To prepare the student for additional water safety skills designed to improve his/her stamina and basic coordination.
- 39-161 INTERMEDIATE SWIMMING** I A,B; II A(0,2)5
To give the student practice in learning and mastering the basic leg and arm movements essential to good swimming in the front crawl, elementary backstroke, side stroke and breast stroke.
- 39-162 PRE-LIFESAVING** II A(0,2)5
To increase the student's endurance and versatility in the water by providing opportunities to coordinate the parts of a stroke into the whole stroke as well as mastering turns on front, back, and side to employ a wider range of strokes in a closed course. (Prerequisite: 39-161 or its equivalent.)
- 39-163 ADVANCED LIFESAVING** II B(0,4)1
To provide the student with the knowledge and skills designed to save his own life or the life of another in the event of an emergency. The training is not intended to be a complete lifeguard training course. (Prerequisite: 39-123 and 39-162.)
- 39-169 WATER SAFETY INSTRUCTOR'S (WSI)** II(0,4)2
To give the instructor-candidate the knowledge, judgement, teaching skills necessary to train others in swimming skills. To instill a high degree of personal efficiency in swimming and lifesaving skills in order to teach safety in, on, or about the water. (Prerequisite: 39-123 and 39-163 or their equivalent.)
- 39-114 INTERMEDIATE TENNIS** I A; II B(0,2)5
Emphasis will be placed on baseline stroking, net play, serves, and effective strategy in singles and doubles. (Prerequisite: 39-116 or permission of the instructor.)
- 39-115 INDIVIDUAL SPORTS** I A,B; II A,B(0,2)5
To cover rules, strategy, strokes, and etiquette of both handball and squash. In addition, discussion also includes the history of the activities with a comparison of the English and American games.
- 39-116 BEGINNING TENNIS** I A; II B(0,2)5
To acquaint the novice player to forehand, backhand, serve, rules, etiquette, and elementary strategy of tennis. It is hoped that the students will be able to rally successfully at the end of this six week course.
- 39-117 ONE-WALL RACQUETBALL** I A,B; II A,B(0,2)5
To cover rules, strokes and strategy of this game which was the forerunner of the four-wall game.
- 39-120 WEIGHT TRAINING** I A,B; II A,B(0,2)5
The program is designed for individual instruction in all phases of weight training and is designed to acquaint the student with the benefits of weight training as a method of conditioning.
- 39-123 STANDARD FIRST AID** I A,B; II A(0,2)5
Upon successful completion of this course, students will be certified by the American Red Cross. This course is a prerequisite to Advanced Lifesaving and to WSI.

39-126 BADMINTON

I B; II A,B(0,2)5

To introduce and to refine the basic strokes, footwork, and game strategy of both singles and doubles. In addition, time will be spent on the proper etiquette and the laws of badminton, a fast-paced game.

39-127 WOMEN'S GYMNASTICS

I B; II A,B(0,2)5

For students who have had some previous experience in gymnastics and who are interested in improving their skills and form on the balance beam, unevens, horse, and trampoline.

39-170 JUDO

I A,B; II A,B(0,2)5

Designed to develop the individual's character, physical abilities, coordination, and balance. Students completing written and practical examinations will be eligible to progress in the various ranks of Judo.

39-173 AIKIDO

I A,B(0,2)5

Knowledge, skill and understanding of historical development and nature of the sport are taught. Designed to develop the individual's character, physical abilities, coordination, and balance.

39-180 FIFTY MILE SWIM

I A,B; II A,B(0,2)5

To encourage the student to swim regularly and frequently until 50 or more miles are reached in order to improve the fitness level of the swimmer and to correct faulty stroke mechanics. Red Cross.

39-227 INDEPENDENT ACTIVITY

I A,B; II A,B(0,2)5

For students with severe scheduling problems who can present evidence of being able to formulate and to execute an individual program of their own in consultation with the instructor. (Permission of the instructor.)

39-232 SAILING

I A,B(0,2)5

Skills and techniques; sailing on the Merrimack River.

FACULTY OF THE COLLEGE OF HEALTH PROFESSIONS**DEAN OF THE COLLEGE**

Eleanor Forsley Shalhoup, R.N.; B.S.; M.S.; C.A.G.S.; Ed.D.

ASSISTANT DEAN

Sarah Moroney, B.S.; M.S.

DEPARTMENT CHAIRPERSONS

Richard M. Aronson, B.S.; Ed.M.; C.A.S., Ed.D., Physical Education

Joseph A. Dorsey, B.S.; M.S.; C.A.G.S.; Ed.D.; Physical Therapy

Alease Bruce, B.S.; M.S.; Ph.D., Clinical Laboratory Sciences

May Futrell, R.N.; B.S.; A.M.; Ph.D.; Nursing

Karen M. Lorentzen, R.N.; B.S.; Ed.D.; Health

RESIDENT FACULTY

Richard M. Aronson, Associate Professor, Physical Education; B.S., Springfield College; M.Ed., Boston University; C.A.S., Springfield College; Ed.D., Boston University.

Louise Battista, Instructor, Nursing; B.S.N., U. of Pennsylvania; M.A., New York University.

Alease Bruce, Associate Professor, Clinical Laboratory Sciences; B.S., Hampton Institute; M.S., Ph.D., Howard University.

Robert T. Callary, Assistant Professor, Physical Education; B.S., Springfield College; M.Ed., Fitchburg State College.

A. Grant Carrow, Instructor, Physical Education; A.B., University of New Hampshire.

Claire Chamberlain, Associate Professor, Physical Education; B.S. in Ed., Ed.M., Tufts University; C.A.G.S., Northeastern University.

Barbara A. Cocanour (Hilton), Assistant Professor, Physical Therapy; A.B., Defiance College; M.S., Ph.D., University of Maine.

Carolyn Cochrane, Assistant Professor, Nursing; B.S., Northeastern University; M.S., Boston University; Ph.D., University of Texas at Austin.

Barbara A. Dalton, Instructor, Nursing; R.N., Greenwich Conn. Hospital; B.S.N., Syracuse University; M.S.N., Yale University.

Joseph A. Dorsey, Professor, Physical Therapy; Chairperson, Department of Physical Therapy; B.S., Springfield College; M.Ed., Northeastern University; C.A.G.S., New York University; Ed.D., Boston University.

Kathleen M. Doyle, Instructor, Clinical Laboratory Sciences; B.S., University of Massachusetts; M.S., University of Lowell.

Marian D. Dubrule, Assistant Professor, Nursing; B.S., Iowa State University; M.N., Yale University; M.Ed., M.S., Ed.D., Boston University.

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Sandra L. Fessia, Assistant Professor, Clinical Laboratory Sciences; B.A., University of Texas; M.S., Ph.D., Wayne State Medical School.

Michael Frechette, Associate Professor, Clinical Laboratory Sciences; B.S., Merrimack College; Ph.D., University of Rhode Island.

May Futrell, Professor, Nursing; B.S., A.M., Columbia University; Ph.D., Brandeis University.

Merry Lynne Hamilton, Instructor, Physical Therapy; B.S., University of Connecticut; M.S., University of Massachusetts.
 M. Susan Haussler, Instructor, Nursing; B.S.N., Cornell University; M.S. Boston University.
 Alison E. Holness, Assistant Professor, Physical Therapy; M.S.C.P., London; B.P.T., University of Manitoba; M.Ed., Northeastern University.
 Mona C. Hull, Professor, Health (Health Services Administration); A.B., Mt. Holyoke College; M.N., Yale University; C.A.G.S., Ph.D., Boston University.
 Beverly A. Johnson, Instructor, Nursing; B.S., University of Massachusetts; M.S., Boston University.
 Linda A. Kahn, Assistant Professor, Physical Therapy; B.A., Merrimack College; M.A., Texas Women's University.
 Jeff Kushner, Assistant Professor, Clinical Laboratory Sciences; B.S., M.S., S.U.N.Y., Buffalo.
 Jacob W. Lam, Professor, Clinical Laboratory Sciences; B.S., University of Illinois; M.S., University of Tennessee; Ph.D., University of Massachusetts.
 Denise I. Legault, Associate Professor, Physical Education; B.S., Bridgewater State College; M.Ed., C.A.G.S., Springfield College.
 Joan D. Lewis, Assistant Professor, Nursing; B.S., M.Ed., Boston College; Ed.D., Boston University.
 Karen M. Lorentzen, Associate Professor, Health (Health Education); R.N.; B.S., Adelphi College; M.S., St. John's University; Ed.D., Boston University.
 Diane F. Mahoney, Instructor, Nursing; B.S., Boston College; M.S., University of Lowell.
 Elizabeth M. Malek-Potter, Assistant Professor, Physical Therapy; B., University of Queensland, Australia; B.Sc., M.Ed., Worcester State College; D.Ed., Boston University.
 Sarah C. Moroney, Instructor, Nursing; B.S., Boston College; M.S., Boston University.
 Elizabeth L. Mullett, Professor, Nursing; R.N.; B.S., Simmons College; M.Ed., Ph.D., Boston University.
 Theodore Namm, Associate Professor, Clinical Laboratory Sciences; B.S., M.S., Fordham University; Ph.D., University of New Hampshire.
 Robert B. Neal, Associate Professor, Health (Health Education); B.A., University of Massachusetts; M.Ed., Ed.D., Boston University.
 A. James Oliver, Associate Professor, Physical Education; B.S., Boston University; M.Ed., Boston State College.
 Anna K. Omery, Assistant Professor, Nursing; A.S.D., Lexington Technical Institute; B.S., Northeastern University; M.S., Boston University.
 Louise Rauckhorst, Associate Professor, Nursing; R.N.; B.S., St. Joseph College; M.S.N., Catholic University of America; Ed.D., Columbia University.
 Marilyn M. Rawnley, Professor, Nursing; B.S.N., St. Anselm's; M.S., Boston University; D.N.Sc., Boston University.
 Linda C. Roemer, Assistant Professor, Health; A.B., Stanford University; M.A., Ph.D., Tufts University.
 Eugene Rogers, Instructor, Clinical Laboratory Sciences; B.S., Lowell State College; M.S., Northeastern University.
 Eleanor Forsley Shalhoup, Professor, Nursing; R.N.; B.S., St. Anselm College; M.S., C.A.G.S., Ed.D., Boston University.
 Janice M. Stecchi, Associate Professor, Nursing; R.N.; B.S.N., Boston College; M.Ed., Salem State College; M.S., Ed.D., Boston University.
 James E. Stone, Assistant Professor, Physical Education; B.S., Springfield College.
 Grace R. Sullivan, Assistant Professor, Nursing; R.N.; B.S., M.S., University of Lowell.
 Linda M. Svetz, Instructor, Nursing; R.N.; B.S., Salem State College, M.S., Boston University.
 Eileen Williamson, Assistant Professor, Nursing; R.N.; B.S., Lowell State College; M.S., Boston University.

ADJUNCT FACULTY

Stephen Brovender, Clinical Nursing; B.S., Brooklyn College; M.D., University of Brussels.
 Veronica Charbonneau, Clinical Nursing; B.S., Union University; M.S., University of North Carolina.
 Susan Houde, Clinical Nursing; B.S., Lowell State College; M.S., University of Lowell
 Patricia Kraepelien-Bartels, Clinical Nursing; B.S., R.N., M.S., University of California.
 Manlio LoConte, Clinical Physical Therapy; M.D., University of Padua.
 Karen M. Melillo, Clinical Nursing; A.S.D., Mass. Bay Community College, B.S.N., Salem State College, M.S.N., University of Lowell.
 William O'Rourke, Clinical Nursing; B.A., St. Bonaventure University; M.A., Holy Name College; M.Ed., University of New Hampshire; Ph.D., Boston College.
 Nancy Peatman, Clinical Physical Therapy; B.S., University of Connecticut; M.Ed., Fitchburg State College.

PROFESSIONAL SUPPORT STAFF

Dorothy Boisvert, Clinical Medical Technology; B.S., Boston University; M.S., University of Lowell.
 Barbara Callahan, Clinical Medical Technology; B.S., Anna Maria College
 Catherine Salerno, Clinical Medical Technology; B.S., University of Lowell.
 Elizabeth Tavoularis, Clinical Nursing; R.N., B.S., Columbia University; M.S., Boston University.

CLINICAL FACULTY: DEPARTMENT OF CLINICAL LABORATORY SCIENCES

Lowell General Hospital

Agostinelli, Donald: Chief Pathologist & Medical Director; M.D., Yale University School of Medicine.
 Cox, Alan: Clinical Medical Technologist - Coordinator; M.T. (ASCP); B.A. Iowa Wesleyan College.
 Hood, Florence: Clinical Medical Technologist - Hematology; B.S., Merrimack College; M.S. University of Massachusetts
 Inderbitzen, Paul: Clinical Medical Technologist - Blood Bank; M.T. (ASCP); B.S. Canisius College.
 Nattal, Margaret: Clinical Medical Technologist - Microbiology; M.T. (ASCP); B.S., S.M.U., North Dartmouth
 Savastano, Roland: Clinical Medical Technologist - Chemistry; M.T. (ASCP); B.S., Merrimack College.
 Correia-Branco, Manuel Joao, Clinical Medical Technologist; Lowell General Hospital Urologist; M.D., Lisbon University Medical School (Portugal)

St. John's Hospital

Andrusaitis, Benjamin: Clinical Chemistry Supervisor; M.T. (ASCP); B.S., University of Lowell; (awaiting M.S. in Spring 1982 Northeastern University)
 Black, Mary Jane: Assistant Supervisor of Microbiology; M.T. (ASCP); B.S. Merrimack College
 Dickson, Karen: Supervisor of Hematology; M.T. (ASCP); B.S. Southeastern Massachusetts University.
 Fawcett, Priscilla A.: Supervisor Microbiology; M.T. (ASCP); B.S. Fitchburg State College.
 Hughes, Audrey C.: Laboratory Coordinator; M.T. (ASCP); B.A. College of Notre Dame, MD; M.A. Boston University
 Keating, Rita B.: Supervisor - Instructor Blood Bank; M.T. (ASCP); B.S. Mt. St. Mary College, Hooksett, N.H.

Killeen, Ann Marie: Assistant to the Laboratory Coordinator; M.T. (ASCP), M.S., B.S. Rivier College, Nashua, N.H.

LoConte, Manlio A.: Pathologist, M.D. University of Padua, Padua, Italy

Koning, Sharon L.: Educational Coordinator; M.T. (ASCP); B.S. University of Vermont

McGoldrick, David M: Pathologist, Director of Laboratory, M.D. Cornell University Medical School

St. Joseph's Hospital

Ferrara, Shirlee: Supervisor of Hematology & Clinical Microscopy, M.T. (ASCP) B.A. University of Connecticut

Gorczyca, Kathleen M: Supervisor of Chemistry; M.T. (ASCP); B.S. University of Massachusetts;

Harrison, Norman B.: Clinical Chemist; M.T. (ASCP); M.S. University of Bridgeport

Jean, Theresa C.: Clinical Medial Technologist - Blood Bank, M.T. (ASCP); St. Louis Academy, CLA St. Joseph's Hosp., HEW Nat. Exam.

Norton, James H., Jr.: Pathologist; M.D. Johns Hopkins University.

Ryan, Sharon A.: Supervisor of Microbiology; M.T. (ASCP); B.S. University of Lowell.

COLLEGE OF MANAGEMENT SCIENCE

Benjamin Chinitz, Dean

Joseph Thomas, Assistant Dean

The beginning of the twentieth century heralded the advent of an interdependent and urbanizing society in which business and business decisions became increasingly complex. The development of business theories, notably Taylor's scientific management, stressed the need for the study and research of business problems. In response many of the nation's leading universities established schools of business. In the succeeding fifty years, these schools flourished. However, they tended to emphasize specific business problems and areas rather than generalized solutions. Their emphasis was primarily vocational. Students, for the most part, were prepared for a particular position in a particular industry.

In the late 1950s, the Carnegie Corporation and the Ford Foundation each sponsored separate studies of the state of collegiate education for business. The studies came to similar conclusions. They were critical of curriculums that trained students for narrow specialized tasks. They stressed the need for placing the major emphasis on analytical decision making in a rapidly changing economic environment. Their recommendations were influential in initiating critical self-studies by business schools. The resulting changes led to a fundamental change in business school curriculums. Schools turned their attention from particular occupations and industries to the study of organizations. Emphasis was placed on developing analytical tools and techniques that could be applied to the solution of common administrative problems, be they in business, government or non-profit organizations.

The improved quality of offerings made business graduates more valuable to employers. These employers include governmental bodies and non-profit organizations as well as private businesses. These factors, together with the growth of the economy, sharply increased the demand for accountants, applied economists, managers and other business professionals. This trend is expected to continue well into the next century.

OBJECTIVES OF THE COLLEGE OF MANAGEMENT SCIENCE

The College of Management Science is one of the larger collegiate schools of business in Massachusetts. In terms of publicly supported higher education for business, it is second only to the University of Massachusetts at Amherst. The College is a member of the American Assembly of Collegiate Schools of Business and offers several standard business programs. It seeks to provide its students with an education, the quality of which will enable them to function successfully as professionals in business and nonbusiness organizations. The key elements of a quality education are content and method. The faculty through research, consulting, and other scholarly activities strives to keep pace with the rapidly changing subject matter in their fields, and utilize a variety of teaching methods with emphasis on the lecture and case method techniques.

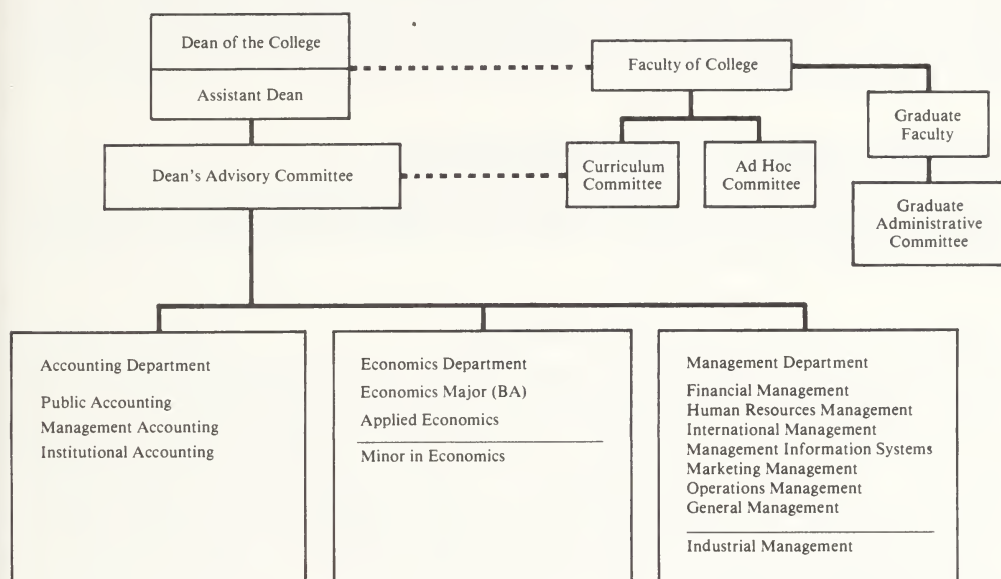
In addition to its own majors, the College services other students at the University. The industrial technology program requires that its students take about a third of their courses in management science subjects. The College of Health Professions' program in health serves and the College of Music Program in Music Business utilize certain courses in Business. Other students throughout the University are required or elect to take management science courses.

The college also participates in efforts to revitalize the region's economy. Faculty are encouraged to direct their research efforts to deal with regional business and economic issues. The resources and experience of the College are made available to assist in the solution of problems faced by business and governmental units in the Merrimack Valley.

COLLEGE ORGANIZATION & GOVERNANCE

The College of Management Science is organized into three departments and is administered by a dean, who is assisted by an advisory committee. The three departments are responsible for developing course offerings and programs of studies. The faculty of the College has overall responsibility for all academic policies of the College. The Dean's Advisory Committee makes policy recommendations and also serves as a review body for suspended students seeking readmission with probationary status.

ORGANIZATION CHART



Dean's Advisory Committee (Academic Standards Committee)

Benjamin Chinitz, Dean
 Albert Cederlund, Economics
 Charles Feeney, Accounting
 Stuart Freedman, Management
 Brackston Hinchey, Management
 Paul Snoonian, Economics
 Charles Thompson, Accounting

BACCALAUREATE DEGREE PROGRAMS

The College of Management Science offers undergraduate programs leading to the degree of Bachelor of Arts, Bachelor of Science in Business Administration, and Bachelor of Science in Industrial Management. For details concerning graduate business programs, see the *Graduate School Catalogue*.

Bachelor of Arts Degree

The Bachelor of Arts degree is offered with a major in economics. This degree program provides opportunities for pursuing an economics major within the context of more flexible curriculum requirements than are permitted for economics students who pursue the professional degree of Bachelor of Science in Business Administration. University requirements concerning the Bachelor of Arts degree are stated elsewhere in this publication under the heading "Academic Policies: Baccalaureate Degrees" and "Academic Policies: Major Field Requirements."

Bachelor of Science in Business Administration Degree

The Bachelor of Science in Business Administration degree is designed to provide students with those liberal arts and science foundations, analytical skills, and specialized professional courses which will enable them to function as effective professional administrators in business. The first two years are comprised of liberal arts, science and professional skill courses. These subjects provide the foundation on which the advanced courses are built. In the liberal arts and sciences, emphasis is upon written English, the behavioral sciences (psychology and sociology),

and mathematics— including an introductory computer course. The professional skill courses include accounting, economics, and statistics. During the last two years students take professional course courses in business law, finance, government and business, marketing, operations management, managerial economics, and business policy. In addition, students select program options in accounting, economics, or management. Regardless of department options elected, students have sufficient electives which permit them to tailor their programs to their special interests.

Bachelor of Science in Industrial Management

The degree of Bachelor of Science in Industrial Management is designed to provide students with a specialized education in technological and management areas and is an inter-collegiate program of the College of Engineering and the College of Management Science.

GENERAL COLLEGE REQUIREMENTS

Each candidate for an undergraduate degree must satisfy the general University requirements for graduation and must complete all requirements as specified by one of the established curricula within the College.

Due to the structured nature of the baccalaureate programs in business administration and industrial management, students who matriculate in other colleges of the University may not minor in business or industrial management. Such students may minor in economics or may elect other management science courses. They may also elect a second major in the College of Management Science provided that they also complete all related requirements as specified by the concerned department of the College of Management Science.

Residency Requirement

In addition to the minimum University residency requirements, the College of Management Science requires the senior year's work, with minor exceptions to be taken in residence at the College of Management Science.

Declaration of Major

Students enrolled in the College of Management Science of necessity are committed to pursue one of the established college programs and are required to declare their choice of degree program upon enrollment. Students pursuing the Bachelor of Science in Business Administration degree pursue a core program for the first two years and are required to declare a program option by the end of the sophomore year. In any event, all students are required to file specific declarations of major or degree programs with the Office of the Registrar no later than the beginning of their junior year. Students enrolled in the College of Liberal Arts who wish to elect a second major in economics must secure the approval of the chairperson of the Department of Economics prior to making such a declaration and must file the appropriate University form with the Office of the Registrar no later than the end of the sophomore year. During the first semester of their senior year, students are required to file a Declaration of Intention to Graduate (DIG) form with their major department's designed to DIG officer.

Change of Major

Bachelor of Arts degree candidates in the College of Management Science may not drop the economics major without withdrawing from the University, transferring to another college of the University, or changing their degree program to the Bachelor of Science in Business Administration or the Bachelor of Science in Industrial Management. Students who wish to change their major and degree program within the College of Management Science must secure the approval of the chairperson of the appropriate department of the College. Students who wish to drop their program or major in the College of Management Science and to elect a major offered by another college of the University should consult the policy concerning intercollegiate transfer within the University which appears in the publication concerning *Admission Regulations and General Academic Rules*. All such changes of program require notification of the Office of the Registrar through the filing of the form for Declaration of Major or Change of Major. Students who withdraw from the University must do so through the Office of

the Registrar. Bachelor of Arts degree candidates may change their minor studies when changing their majors and may substitute alternative minor programs without changing majors. Such changes are subject to the established regulations of the colleges in which such studies are pursued. Additional course work beyond the minimum 120 credits and extension of the normal four-year period of study may be expected for students who change their major options later than the first semester of their junior year or who change their degree program later than the end of the freshman year.

Students who are candidates for the Bachelor of Science in Business Administration may change their degree programs when they have received the permission of the chairperson of the appropriate department. Students may transfer into Bachelor of Science in Business Administration and Bachelor of Science in Industrial Management programs from other colleges of the University. However, students making such a transfer may need to extend their period of study beyond the normal eight semesters, particularly if they transfer after the second semester of the sophomore year.

Transfer Policies

Students transferring to the College of Management Science from other colleges of the University or from other accredited institutions may expect recognition of previously completed courses if these are equivalent to those specified by curricula of the College.

Transfer from Other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University requirements when a student is admitted to the University and are also evaluated by professional departments in terms of college and program requirements at the time a student is accepted for matriculation in the College of Management Science. Courses which are transferred to the University under provisions of the Massachusetts Transfer Compact and which are not creditable to requirements of the College of Management Science or as unrestricted elective courses will be listed on the student's permanent record card but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University under the Massachusetts Transfer Compact subsequently makes an intercollegiate transfer to the College of Management Science, all previously completed courses, including transferred courses from the compact institution, will be reevaluated in terms of their applicability to degree requirements of the College of Management Science.

The applicability of grades received in transferred courses for the determination of the grade-point average of the student's major at the University of Lowell is determined by policies of each of the colleges. The policy of the College of Management Science is not to count such grades for the purpose of determining the student's major grade-point average.

Repetition of Transferred Courses

A student who has been granted transfer credit, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted on filing an academic petition form through the office of the College dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Management Science

Students wishing to transfer from another college of the University, or from baccalaureate continuing-education programs of the Evening School, must have completed successfully 15 credits with a cumulative G.P.A. of not less than 2.0 and must file a petition, together with a transcript of their permanent record cards, with the appropriate chairperson and the Dean of the College of Management Science by November 1 for spring semester transfer and by April 1 for fall semester transfer. Students are referred to University policies concerning intercollegiate transfer which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with

Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Office of the Dean and, irrespective of grades previously received in other college programs, all courses which may not be applied to college or program requirements are deleted from the student's cumulative grade-point average.

Cooperative Education and Contract Learning Program

The College of Management Science is a full participant in the University Cooperative Education Work Experience Program and eligible students may elect to petition for participation in the Program. Through Contract Learning, the student is provided with an opportunity to learn more about various professional fields within the College of Management Science. To qualify, a student must have a grade-point average of at least 2.50 and must be a second semester junior. The heart of the program rests in the contract drawn by the student and presented to a faculty sponsor. The student submits to a faculty sponsor an outline of the project to be pursued. The proposal includes a statement of the relationship of the proposed project to a theory or technique applicable to a student's major. For further information, students should refer to policies which appear elsewhere in this publication under the heading "Academic Policies: Cooperative Education" and should consult with their department chairpersons.

DEPARTMENT OF ACCOUNTING

Charles F. Feeney, Chairman

Professors: William Burke, Clairmont Carter, Gerald Downey, Charles Feeney, Linda Kistler, George Toscano (Emeritus)

Associate Professor: Russell Karl

Assistant Professors: Samuel Chesler, Brook Hargreaves-Heald, Daniel Jones, George Nogler, Rosanne Riddick, Charles Thompson

Instructor: John Hamer

The Department of Accounting offers an accounting program which leads to the degree of Bachelor of Science in Business Administration.

Accounting Program

The fundamental objective of the accounting program is to prepare students for professional positions in public accounting, management accounting, and governmental or not-for-profit accounting. The program offers a rigorous preparation for professional careers by providing several "concentrations" to fit the needs of a diverse student body in the College of Management Science.

The three concentrations available within the accounting program are as follows:

Public Accounting Option

Students interested in public accounting careers are expected to enroll in courses designed to prepare them for specialized activities in auditing, management information systems, and taxation. Because of the intense competition for positions in public accounting firms, students selecting this option are expected to demonstrate high standards of academic achievement as well as a firm commitment to public accounting careers. Senior students are encouraged to sit for the CPA examination in May prior to their graduation in June.

Management Accounting Option

Students desiring to pursue careers in private industry should enroll in accounting courses designed to prepare them for management positions in industrial accounting. Courses in cost accounting, budgeting and standard costs, controllership, and financial analysis are emphasized, and students are encouraged to complete elective courses in finance as well as accounting in order to offer as broad a background as possible in subjects which are encountered in a private enterprise environment.

Institutional (Not-For-Profit) Accounting Option

Federal, state, and local governmental units have become increasingly influential in the American economy. The growth of these institutions as well as other not-for-profit institutions such as schools and hospitals have created emerging opportunities for service as professional accountants. Students desiring to specialize in not-for-profit accounting are advised to obtain a strong foundation in financial, cost, and tax accounting and to enroll in the governmental accounting and management information systems electives.

Accounting students interested in management information systems may also elect the following courses and use them as accounting electives: 66-404, Computer Applications to Management; 66-473, Operations Management III; 66-475, Systems Analysis; 66-477, Information Systems Management; and 66-478, Problems in Information Systems.

Students desiring to obtain a general accounting background may select a variety of courses from a large number of accounting electives while completing basic requirements for the accounting program.

The accounting discipline is intended to provide students with quantitative analytical skills necessary for developing financial information for management, the public, and not-for-profit institutions. Data accumulation, analysis, and interpretation together with communication of results are fundamental activities of professional accountants. The specialties within the accounting program at the University of Lowell are designed to prepare graduates for service in a dynamic and respected profession.

COURSE OF STUDY FOR BUSINESS ADMINISTRATION (ACCOUNTING)#

Lower Division: Common to All Business Administration Curricula

Freshman Year

Fall Semester

42-101 College Writing	3
92-121 Pre-Calculus Mathematics	3
47-101 General Psychology	3
* History or Political Science Elective	3
** Science Elective	3-4
39-100 Physical Education	1

Spring Semester

42-102 College Writing II	3
92-122 Differential Calculus	3
48-101 Sociology	3
* History or Political Science Elective	3
** Science Elective	3-4
39-200 Physical Education	1

16-17

16-17

*Recommended is Western Civilization Before and After 1715. However, another history or political science may be chosen.

**Recommended are 83-101 and 83-102, Life Science I and II, but a course from the departments of physics, chemistry or geology may be elected.

Sophomore Year

Fall Semester

60-201 Accounting Principles I	3
64-211 Statistics I	3
64-201 Economics I	3
92-201 Integral Calculus	3
* 66-253 Organizational Behavior	3

15

Spring Semester

60-202 Accounting Principles II	3
64-212 Statistic II	3
64-202 Economics II	3
92-242 BASIC with Business Applications	3
42-224 Business Writing	3

15

Sophomores will be split into two groups alternating 42-224 with 66-253.

Upper Division: Accounting Program

Junior Year

Fall Semester

60-301 Intermediate Accounting I	3
66-321 Marketing Principles	3
66-331 Business Finance	3
66-371 Operations Management I	3
60-362 Business Law I	3

15

Spring Semester

60-302 Intermediate Accounting II	3
66-332 Money and Banking	3
64-307 Government, Business and Society	3
60-411 Cost Accounting I	3
Area II Elective	3

15

Senior Year

Fall Semester

60-401 Advanced Financial Accounting I	3
64-312 Managerial Economics	3
Accounting Elective	3
Area II Elective	3
General Elective	3

15

Spring Semester

66-498 Business Policy	3
Accounting Elective	3
College of Management Science Elective	3
Area I, II or III Elective	3
EGeneral Elective	3

15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Accounting (Course Prefix: 60)

60-201 ACCOUNTING PRINCIPLES I

I(3,0)3

Presents a comprehensive and detailed exposure to basic accounting theory. Beginning with the accounting equation, the student is introduced to the accounting cycle, preparation of the Statement of Financial Position and the Income Statement, and accounting for the assets of a firm.

60-202 ACCOUNTING PRINCIPLES II

II(3,0)3

Emphasizes the accounting for corporations, treatment of stockholders equity, earnings and dividends. Examines the Statement of Changes in Financial Position, cash flow causes and effects, and financial statement analysis. Prerequisite: 60-201.

60-301 INTERMEDIATE ACCOUNTING I

I(3,0)3

This course examines the generally accepted accounting principles relating to the preparation of financial statements. The student will study in depth the valuation and disclosure problems associated with the assets of the firm. Prerequisite: 60-202.

60-302 INTERMEDIATE ACCOUNTING II

II(3,0)3

This course continues the in-depth study of the valuation and disclosure problems associated with corporate liabilities and stockholders equity. Emphasis is placed on the opinions of the Accounting Principles Board and Financial Accounting Standard Board. Prerequisite: 60-301.

60-311 MANAGERIAL ACCOUNTING

I(3,0)3

An in-depth examination of the use of accounting systems for managerial decision-making. Budgeting, forecasting, and cost accumulations systems which relate to the manufacturing firm will be studied. Prerequisite: 60-202. (For Non-Accounting Majors.)

60-362 BUSINESS LAW I

I, II(3,0)3

This course introduces the student to the fundamentals of criminal and tort law. The main emphasis is on all aspects of contract law including the agreement, consideration, the writing, third party rights, illegality, performance, and remedies. Also covered is agency law concerning all situations where one party is working for another in the business world. This course is recommended at the junior level.

60-363 BUSINESS LAW II

I, II(3,0)3

This course continues the study of law and its impact on the business world. Partnerships, limited partnerships, and joint ventures are studied at the outset of the course. The main emphasis is on all elements of the corporate structure. The last part of the course deals with personal and real property with some coverage of wills and trusts. Prerequisite: 60-362.

60-364 BUSINESS LAW III

I(3,0)3

This course is recommended for the senior level student especially those studying for the C.P.A. examination. It deals exclusively with the Uniform Commercial Code including Sales, Bills and Notes, Secured Interests, and Bulk Sales. Prerequisites: 60-362 and 60-363, or permission of instructor.

60-365 LAW AND SOCIETY

I(3,0)3

This course deals with the manager's role in understanding and determining the firm's relations with government and society. Topics relating to government include the tax and regulatory provisions of local, state, and federal agencies including such matters as antitrust, mergers, and licensing. Topics relating to society include the social cost aspects of business, civil rights, business ethics, and problems in ecology.

60-366 INTERNATIONAL LAW

II(3,0)3

This course is recommended at the senior level. This course covers the International Legal Process including the sources of international law and its history. It covers specific problems in international law such as war prevention, economic well being, environmental considerations and sociopolitical justice. It further explores legal perspectives of law and global reforms as well as the promotion of humane world order values. Prerequisite: 30-362 or permission of the Instructor.

60-401 ADVANCED FINANCIAL ACCOUNTING I

I(3,0)3

This course explores theoretical and practical problems in accounting for large, multicorporation business entities. Consolidation, mergers and home office/branch accounting receive in-depth study. Prerequisite: 60-302.

- 60-402 ADVANCED FINANCIAL ACCOUNTING II** II(3,0)3
This course offers a comprehensive study of partnership accounting, accounting for installment and consignment sales, and also includes an introduction to accounting for nonprofit organizations (government, educational units and hospitals). Prerequisite: 60-401.
- 60-411 COST ACCOUNTING I** I(3,0)3
An examination of the manufacturing function from the view of the cost accountant. Managerial control of the elements of product costs will be studied with an emphasis on cost accumulation systems both historical and estimated. Prerequisite: 60-202.
- 60-412 COST ACCOUNTING II** II(3,0)3
Topics covered will include standard (estimated) costs, variance analysis, profit planning, cost-volume-profit analysis, and relevant cost analysis for problem solving. Prerequisite: 60-411.
- 60-421 AUDITING I** I(3,0)3
An examination of purposes of financial and operations auditing. The following topics will be examined in depth: auditing standards, professional ethics, legal responsibilities, internal control, audit evidence, financial statements disclosures, audit reports, management advisory services, and internal auditing. Prerequisite: 60-302.
- 60-423 FINANCIAL ACCOUNTING THEORY AND PRACTICE** I(3,0)3
Prepares interested students for the various parts of the C.P.A. exam. Only those interested in a career in public accounting should enroll.
- 60-424 INTERNATIONAL ACCOUNTING** I(3,0)3
This course deals with the differences in Accounting theory and practice between the major industrial countries with emphasis on inflation, transfer pricing and fundamental differences in generally accepted Accounting principles. Prerequisite: 60-362.
- 60-431 FEDERAL INCOME TAXES** I(3,0)3
This course deals with the basic rules and regulations of the Internal Revenue Code as it affects the individual and the corporation. An understanding of the code is developed through lectures, assigned readings, research, and the solution of a wide variety of problems. Prerequisite: 60-202.
- 60-432 ADVANCED FEDERAL TAXATION** II(3,0)3
This course deals with the rules and regulations of the Internal Revenue Code as it effects corporations, estates and trusts. Emphasis will be on special corporate problems including incorporation, distributions and liquidations. Prerequisite: 60-431.
- 60-441 ACCOUNTING FOR NOT FOR PROFIT INSTITUTIONS** I(3,0)3
Examines financial accounting methods, principles and systems, as related to state, county and local governments, colleges and universities, and hospitals. While Fund accounting concepts provide the general framework of the course, expenditure controls are given particular attention through an examination of appropriation and encumbrance accounting. This course is appropriate for students intending to become certified public accountants and those who have interest in working for service related institutions in the nonprofit section of the economy. Prerequisite: 60-302.
- 60-451 CONTROLLERSHIP** I(3,0)3
Functions and procedures of the controller in modern business. Emphasis upon control systems which safeguard assets and assist in efficient utilization of the firm's sources. Special attention placed upon long-range operational planning and control. Prerequisite: 60-302.
- 60-453 SYSTEMS ANALYSIS** I(3,0)3
Equivalent to 66-475. See Management Courses.
- 60-454 INFORMATION SYSTEMS MANAGEMENT** I(3,0)3
Equivalent to 66-477. See Management Courses.
- 60-455 PROBLEMS IN INFORMATION SYSTEMS** II(3,0)3
Equivalent to 66-478. See Management Courses.
- 60-499 RESEARCH SEMINAR** (3,0)3
Designed for upperclass Accounting majors who wish to do research and/or investigate special topics of interest

in Accounting. Permission of instructor is required. This course may also be utilized to offer topics to individual students where there are an insufficient number of registrants for a regular class.

DEPARTMENT OF ECONOMICS

Paul Snoonian, Chairman

Professors: Benjamin Chinitz, Daniel Diamond, Thomas Macbeth, Carol McDonough

Associate Professors: Albert Cederlund, George Dery, Susan Goodwin, Richard Healy, Paul Snoonian

Assistant Professors: Edith Lang, Charles Saccardo, Ernesto Sanz, Balbir Sihag

Instructors: James Zeitler

The Department of Economics offers an economics program which leads to the degree of Bachelor of Science in Business Administration, a major in economics which leads to the degree of Bachelor of Arts, and a minor area of study in economics.

Economics Program

(Bachelor of Science in Business Administration)

The economics program is designed to provide a strong background in economic theory and applied economic analysis, within the framework of a business education. In the first two years, the program expands the student's knowledge of mathematics and the liberal arts and introduces him to economics, accounting, and statistics. During the third and fourth years, the student pursues those areas of study which are of particular interest and are consistent with his career objectives; the study of economics is complemented by courses in management, finance, business law, and the humanities.

The goals of the economics program are to provide a sound, working knowledge of economics, preparation for a career in business, and a foundation for graduate study. Since the program equips the student with the techniques of business analysis and problem solving, a graduate is equipped for employment in a variety of fields in business and government. The program is also recommended for students planning graduate study in economics, business, and law.

COURSE OF STUDY FOR BUSINESS ADMINISTRATION (ECONOMICS)#

Lower Division: Common to All Business Administration Curricula

Freshman Year

Fall Semester

42-101 College Writing	3
92-121 Pre-Calculus Mathematics	3
47-101 General Psychology	3
* History or Political Science	
Elective	3
** Science Elective	3-4
39-100 Physical Education	1

16

Spring Semester

42-102 College Writing II	3
92-122 Differential Calculus	3
48-101 Sociology	3
* History or Political Science	
Elective	3
** Science Elective	3-4
39-200 Physical Education	1

16

*Recommended is Western Civilization Before and After 1715. However, another history or political science elective may be chosen.

**Recommended are 83-101 and 83-102, Life Science I and II, but a course from the departments of physics, chemistry or geology may be elected.

Sophomore Year

Fall Semester

60-201 Accounting Principles I	3
64-211 Statistics I	3
64-201 Economics I	3
92-201 Integral Calculus	3
66-253 Organizational Behavior	3

15

Spring Semester

60-202 Accounting Principles II	3
64-212 Statistics II	3
64-202 Economics II	
92-242 BASIC with Business Applications	3
42-224 Business Writing	3

15

*Sophomores will be split into two groups alternating 42-224 with 66-253.

Upper Division: Economics Program

Junior Year

Fall Semester

66-331 Business Finance	3
66-321 Marketing Principles	3
66-371 Operations Management	3
60-362 Business Law I	3
64-303 Microeconomic Theory	3
	15

Senior Year

Fall Semester

64-312 Managerial Economics	3
Economics Elective	3
General Elective	3
College of Management Science	
Elective	3
Area II Elective	3
	15

Spring Semester

66-332 Money and Banking	3
64-304 Macroeconomic Theory	3
64-307 Government, Business and Society	3
Economics Elective	3
Area II Elective	3
	15

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Economics Major (Bachelor of Arts)

Economics as a discipline is concerned with the principles underlying the production and exchange of products and services. The study of economics stems from the scarcity of resources and the limitless nature of our demands for products and services. Societies must therefore choose the goods and services which will be produced from among the larger range of production possibilities. Economics develops the principles and concepts which follow from this fact of scarcity and applies them to the analysis of various aspects of human activity requiring choices among competing alternatives.

The economics major completes a sequence of fundamental economics courses and economics electives which provide a sound knowledge of economic concepts and analyses. The introductory courses survey economic problems, policies, and theory. Required courses in microeconomic and macroeconomic theory and in statistics provide a deeper analytical foundation and the necessary quantitative tools. Economics electives provide students with opportunities to explore subject areas which are of personal interest and which are consistent with their career objectives. The major in economics must include, at a minimum, the following courses:

64-201 Economics I	3
64-202 Economics II	3
64-211 Statistics for Business and Economics I	3
64-212 Statistics for Business and Economics II	3
64-303 Microeconomic Theory	3
64-304 Macroeconomic Theory	3
Economics Electives (minimum requirement)*	12
	30

*At least 9 credits must be taken at the 300 or 400 levels.

Economics majors will be counseled by their faculty advisors to select a minor area of studies or a program of elective courses from such related disciplines as political science, history, sociology, accounting, mathematics and management.

Details concerning requirements for minor programs are provided in the bulletins of the several colleges of the University and these should be consulted by students contemplating minor programs which are not offered by the College of Management Science. Minor programs consist of 18-24 semester credits as specified by concerned departments and must include at least 6 credits of courses which are on or above the 300 level.

Economics Minor*

Students matriculating for degree in other colleges of the University may elect the following program when policies of the colleges in which they are matriculating permit. All minor programs of the University require 18-24 credits and a minimum of 6 credits on the 300 level or above.

64-201 Economics I	3
64-202 Economics II	3
Four (4) Economics Electives	12
	18

*Not available to students in the College of Management Science.

Economics (Course Prefix: 64)

- 64-201 ECONOMICS I** I(3,0)3
A study of the principles of production and exchange. An introduction to demand, supply, pricing and output under alternative market structures. Derived demand and resource markets are introduced.
- 64-202 ECONOMICS II** II(3,0)3
A study of the principles governing the level of national income and employment. Examination of the commercial banking system, monetary and fiscal policy, the international economy, and alternative economic systems.
- 64-211 STATISTICS FOR BUSINESS AND ECONOMICS I** I,II(3,0)3
Descriptive statistics, sophisticated counting techniques and other components of probability, simple random variables and their distributions, bivariate functions, sampling theory, properties of estimators.
- 64-212 STATISTICS FOR BUSINESS AND ECONOMICS II** I,II(3,0)3
Interval estimation, hypothesis testing, analysis of variance, applied regression theory, correlation analysis, and other selected topics. Prerequisite: 64-211.
- 64-302 LABOR ECONOMICS** (3,0)3
The effect of American capitalism on the position of labor. The rise of union organization and the factors in its growth. Trends in the labor force, money and real wages, wage problems and wage differentials, problems of hours and working conditions, and causes and remedies for unemployment. Prerequisites: 64-201, 64-202.
- 64-303 MICROECONOMIC THEORY** I(3,0)3
An advanced examination of price and production theory, the theory of the consumer and the firm. Prerequisite: 64-201.
- 64-304 MACROECONOMIC THEORY** II(3,0)3
An analysis of Keynesian and Post-Keynesian theory. National income accounts, monetary and fiscal policy, and econometric models. Prerequisite: 64-202.
- 64-306 URBAN ECONOMICS** (3,0)3
An introduction to urban economics. Analysis of intrametropolitan spatial relationships including location, land use, and housing markets. Prerequisite: 64-201 or 64-202.
- 64-307 GOVERNMENT, BUSINESS AND SOCIETY** I,I(3,0)3
An examination of various governmental and nongovernmental controls on business and nonprofit organizations. Emphasis is placed on the impact of laws, court interpretations, economic theories, social and political philosophies, and ethical considerations on these organizations. Students will have an opportunity to examine business decisions which involve questions of value and choice. Prerequisite: 64-201.
- 64-310 ECONOMIC DEVELOPMENT OF LESS DEVELOPED COUNTRIES** (3,0)3
The role of capital/private and social technology, labor, governments, international trade and sociocultural and institutional factors in development. Analysis of capital output ratios, social marginal product, disguised unemployment and overpopulation theories. Critical analysis of development strategies. Prerequisite: 64-201.
- 64-312 MANAGERIAL ECONOMICS** I,II(3,0)3
Economic theory and statistical methods applied to business decision making. Estimation of demand, production, and cost functions and accompanying elasticity estimates pricing and output decisions, value maximization problems, and capital budgeting. Prerequisites: 64-201, 64-202, 64-212.
- 64-319 TOPICS IN LATIN AMERICAN ECONOMICS** (3,0)3
Problems faced by the developing countries of Latin America with respect to population, agricultural reform, industrialization, and economic growth. Prerequisite: 64-201 or 64-202.
- 64-381 PERSONAL ECONOMIC PLANNING** (3,0)3
The study of Personal Economic Planning is divided into the following areas: economic principles underlying the concepts of saving, investing, insurance and risk management at the household level; products currently available for use in personal economic planning; development of a framework for use in the application of basic principles to the economic decision-making process necessary for good planning. Prerequisites: 64-201, 64-202.

64-403 INTERNATIONAL TRADE THEORY (3,0)3
The classical and modern trade theories. International payments, exchange and trade controls, and international trade policy determinants. Prerequisites: 64-201, 64-202.

64-404 COMPARATIVE ECONOMICS SYSTEMS (3,0)3
Analysis of free-market and planned economies in theory and practice. Emphasis on the United States and the Soviet Union. Prerequisite: 64-201 or 64-202.

64-407 ECONOMETRICS (3,0)3
Review of the basic regression model, violations of the basic assumptions, estimation with deficient data, multiple regression, formulation and estimations of special models, the generalized linear regression model and its applications, and simultaneous equation systems. Prerequisite: 64-212 or permission of instructor.

64-408 HISTORY OF ECONOMIC THOUGHT (3,0)3
The rise of classical growth and value theories. The evolution of neoclassical theories of price and distribution, and the development of welfare criteria. A comparison Keynesian and classical macroeconomic theory. The role of economic analysis of the post-Keynesian world. Prerequisite: 64-303, and 64-304.

64-411 PUBLIC FINANCE (3,0)3
The economics of the public sector. Principles of public expenditure, taxation, and the public debt applied to federal, state, and local governments. Prerequisites: 64-201, 64-202.

64-499 RESEARCH SEMINAR I,II(3,0)3
An honors course to permit the advanced student to do research in topics of special interest in economics under faculty supervision. Prerequisite: permission of instructor. This course also may be utilized to offer topics to individual students where there are an insufficient number of registrants for a regular class. Some of the topics which have been offered in the past are Mathematics for Economists, Econometrics, Consumer Economics, Welfare Economics and Growth Theory. Prerequisite: permission of instructor.

DEPARTMENT OF MANAGEMENT

Brackston Hinchey, Chairman

Professors: Leslie Dawson, Stuart Mandell, Santo Pullara

Associate Professors: Jack Alexander, Brackston Hinchey, Riaz Khan, Goang Tzer Liaw, James Monahan, Yash Puri, Joseph Rocha, Irwin Shapiro, Louis Yelle

Assistant Professors: Stuart Freedman, Ralph Rieth, Joseph Thomas

Instructors: Harvey Ames, Ingrid Goldschmid, Bhagwat Jaiman

The Department of Management offers a program which leads to the degree of Bachelor of Science in Business Administration. In cooperation with the College of Engineering, the Department also administers the Bachelor of Science in Industrial Management program.

Management Program (Bachelor of Science in Business Administration)

After completion of the freshman-sophomore core subjects, the junior level management major must declare a program option which will consist of a minimum of five advanced courses in a particular management discipline, or interdisciplinary courses in the general management and international management concentrations. The selection of the program option and the courses which comprise it will be made with the assistance of the student's junior-senior faculty advisor. The Department of Management offers an honors program in each of the options. Interested students should see the Department Chairman for details.

The department's seven program options are described below.

Financial Management Option

This concentration introduces the student to two primary areas of financial management: the responsibilities of the treasurer of the business firm, and the financial services function in institutions such as banks, finance companies, and insurance companies. Students choosing this area of concentration are required to take 66-332-Money and Banking; 66-431-Financial Management; 66-432-Financial Institutions and Markets; 66-433-Problems in Finance; 66-434-Investments; and 66-438-International Financial Management.

Human Resource Management Option

The Human Resource Management concentration exposes students to the areas of personnel and industrial relations and those related functions involving the management and development of human resources. Students choosing this area of concentration are required to take 66-451-Personnel Management; 66-452-Industrial Relations; 66-472-Organizational Development; and 66-455-Problems in Human Resource Management; plus any two Human Resources Management electives and one International Management elective.

International Management Option

This program gives the student an understanding of the opportunities and challenges associated with the conduct of business across the boundaries of one's own country. Students in this concentration are required to take 66-438-International Finance; 66-428-International Marketing; 66-402-International Business; 66-493-Multinational Business Policy; two International Management electives; two language electives, and one elective in foreign culture.

Management Information Systems Option

This area of concentration exposes the student to the application of computer-oriented systems techniques in the context of the wide variety of business problems. Students choosing this area of concentration are required to take 66-404-Computer Applications to Management; and 66-475-Systems Analysis; 66-477-Information Systems Management; an International Management elective; plus one of the following: 66-473-Operations Analysis Techniques; 66-478-Problems in Information Systems; 91-301-Information Systems Design (If taken, credit will not be given for 66-477); 91-302-Information System and Implementation Design (If taken, credit will not be given for 66-477); 92-265-Introduction to PASCAL; 92-368-Advanced Cobol Programming; 92-461-System Simulation and Modeling.

Marketing Management Option

Marketing is the function by which the firm responds to changes in its environment. Students choosing this concentration will study the creation and implementation of policies relating to product development, pricing, distribution, and promotion. Marketing students are required to take 66-326-Marketing Research; 66-423-Marketing Management; 66-424-Marketing Strategy Planning; plus an International Management elective and two Marketing electives.

Operations Management Option

This concentration introduces the student to managerial responsibilities in production supervision and control, purchasing, materials management, and physical distribution. Students choosing this concentration are required to take 66-372-Operations Planning and Control; 66-473-Operations Analysis Techniques; and 66-474-Cases in Operations Analysis; plus two Operations Management electives and one International Management elective.

General Management Option

The General Management concentration provides students with a broad background in all areas of management and related disciplines. Students choosing this concentration are required to take 66-404-Computer Applications to Management; 66-431-Financial Management; 66-423-Marketing Management; 66-472-Organizational Development; 66-473-Operations Analysis Techniques; and one International Management elective.

COURSE OF STUDY FOR BUSINESS ADMINISTRATION (MANAGEMENT)#

Lower Division: Common to All Business Administration Curricula

Freshman Year			
Fall Semester		Spring Semester	
42-101 College Writing	3	42-102 College Writing II	3
92-121 Pre-Calculus Mathematics	3	92-122 Differential Calculus	3
47-101 General Psychology	3	48-101 Sociology	3
* History or Political Science Elective	3	* History or Political Science Elective	3
** Science Elective	3-4	** Science Elective	3-4
39-100 Physical Education	1	39-200 Physical Education	1
16-17		16-17	

*Recommended is Western Civilization Before and After 1715. However, another history or political science elective may be chosen.

**Recommended are 83-101 and 83-102, Life Science I and II, but a course from the departments of physics, chemistry or geology may be elected.

Sophomore Year			
Fall Semester		Spring Semester	
60-201 Accounting Principles I	3	60-202 Accounting Principles II	3
64-211 Statistics I	3	64-212 Statistics II	3
64-201 Economics I	3	64-202 Economics II	3
92-201 Integral Calculus	3	92-242 BASIC with Business Applications	3
*66-253 Organizational Behavior	3	42-224 Business Writing	3
15		15	

*Sophomores will be split into two groups alternating 42-224 with 66-253.

Upper Division: FINANCIAL MANAGEMENT

Junior Year			
Fall Semester		Spring Semester	
Area II Elective	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	64-307 Government and Business	3
66-331 Business Finance	3	66-332 Money and Banking OR	
66-371 Operations Management	3	66-333 Multinational Money and Banking	3
General Elective	3	60-362 Business Law	3
15		Area I, II, or III Elective	3
		15	
Senior Year			
Fall Semester		Spring Semester	
66-431 Financial Management	3	64-312 Managerial Economics	3
66-432 Financial Institutions and Markets OR		66-498 Business Policy OR	
66-435 International Financial Institutions and Markets	3	66-493 Multinational Business Policy	3
66-438 International Finance	3	66-433 Problems in Finance	3
General Elective	3	66-434 Investment Management	3
15		General Elective	3
		15	

Upper Division: HUMAN RESOURCE MANAGEMENT

Junior Year			
Fall Semester		Spring Semester	
Area II Elective	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	64-307 Government, Business, and Society	3
66-331 Business Finance	3	66-451 Personnel Management	3
66-371 Operations Management	3	Area II Elective	3
General Elective	3	60-362 Business Law	3
15		15	
Senior Year			
Fall Semester		Spring Semester	
66-452 Industrial Relations	3	International Management Elective	3
* Human Resources Management Elective		66-498 Business Policy	3
66-312 Managerial Economics	3	66-457 Problems in Human Resource Management	3
General Elective	3	* Human Resource Management Elective	3
Area I, II, III Elective	3	66-472 Organizational Development	3
15		15	

* Human Resource Management Electives Include:

- 66-356 Business Research Methods
- 66-453 Management and Contemporary Society
- 66-455 Compensation Management

Upper Division: INTERNATIONAL MANAGEMENT

Junior Year		Spring Semester	
Fall Semester			
60-362 Business Law I	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	60-307 Government, Business and Society	3
66-331 Business Finance	3	66-402 International Business	3
66-371 Operations Management I	3	* Language Elective II	3
* Language Elective I	3	Area II Elective	3
	15		15
Senior Year		Spring Semester	
Fall Semester			
66-428 International Marketing	3	64-312 Managerial Economics	3
66-438 International Finance	3	66-493 Multinational Business Policy	3
* Cultural Elective	3	** International Elective	3
* Cultural Elective	3	** International Elective	3
General Elective	3	General Elective	3
	15		15

*The language sequence and the cultural electives must deal with the same geographic area of the world.

**International Electives Include:

- 66-333 Multinational Money and Banking
- 66-403 Comparative Management
- 66-405 U.S. Business and C.P.E.
- 66-427 Multinational Advertising
- 66-433 Current Problems in Finance and International Business
- 66-435 International Financial Institutions and Markets
- 66-494 Foreign Area Analysis

Upper Division: MANAGEMENT INFORMATION SYSTEMS

Junior Year		Spring Semester	
Fall Semester			
Area II Elective	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	64-307 Government and Business	3
66-331 Business Finance	3	66-475 Systems Analysis	3
66-371 Operations Management	3	Area I, II, or III elective	3
General Elective	3	60-362 Business Law	3
	15		15
Senior Year		Spring Semester	
Fall Semester			
66-404 Computer Applications to Management	3	64-312 Managerial Economics	3
Area II Elective	3	66-498 Business Policy	3
International Management Elective	3	**66-477 Information Systems Management	3
General Elective	3	* Management Information	
General Elective		Systems Elective	3
		General Elective	
	15		15

*Management Information Systems Electives Include:

- 92-265 Introduction to Pascal
- 92-368 Advanced Cobol Programming
- 92-461 Systems Simulation and Modeling
- 66-473 Operations Analysis Techniques
- 66-478 Problems in Information Systems

**91-301 Information Systems Design and

91-302 Information Systems and Implement Design may be taken in place of 66-477.

Upper Division: MARKETING

Junior Year		Spring Semester	
Fall Semester			
Area II Elective	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	64-307 Government, Business and Society	3
66-331 Business Finance	3	66-326 Marketing Research	3
66-371 Operations Management	3	Area I, II, or III Elective	3
General Elective	3	60-362 Business Law	3
	15		15

Senior Year		Spring Semester	
Fall Semester			
66-423 Marketing Management	3	64-312 Managerial Economics	3
* Marketing Elective	3	66-424 Marketing Strategy and Planning	3
* Marketing Elective	3	66-498 Business Policy	3
General Elective	3	International Management Elective	3
General Elective	3	General Elective	3
	15		15

*Marketing Electives Include:

- 66-324 Industrial Marketing
- 66-325 Marketing Communications
- 66-405 U.S. Business and C.P.E.
- 66-421 Purchasing and Materials Management
- 66-422 Retailing
- 66-425 Consumer Behavior
- 66-426 Professional Selling
- 66-427 Multinational Advertising
- 66-428 International Marketing
- 66-429 Special Topics in Marketing
- 66-492 Physical Distribution Management

Upper Division: OPERATIONS MANAGEMENT

Junior Year		Spring Semester	
Fall Semester			
Area II Elective	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	64-307 Government, Business and Society	3
66-331 Business Finance	3	66-372 Operations Planning and Control	3
66-371 Operations Management	3	Area I, II, or III Elective	3
General Elective	3	60-362 Business Law	3
	15		15

Senior Year		Spring Semester	
Fall Semester			
66-473 Operations Analysis Techniques	3	64-312 Managerial Economics	3
* Operations Management Elective	3	66-498 Business Policy	3
General Elective	3	66-474 Cases in Operation Analysis	3
General Elective	3	General Elective	3
Area II Elective	3	International Management Elective	3
	15		15

*Operating Management Electives include:

- 66-372 Operations Planning and Control
- 66-404 Computer Applications to Management
- 66-421 Purchasing and Materials Management
- 66-477 Informations Systems Management
- 66-492 Physical Distribution Management
- 20-476 Statistical Quality Control
- 66-475 Systems Analysis

Upper Division: GENERAL MANAGEMENT

Junior Year		Spring Semester	
Fall Semester			
Area II Elective	3	60-311 Managerial Accounting	3
66-321 Marketing Principles	3	64-307 Government, Business and Society	3
66-331 Business Finance	3	66-404 Computer Applications to	
66-371 Operations Management	3	Management	3
		Area I, II, or III Elective	3
General Elective	3	60-362 Business Law	3
	15		15

Senior Year		Spring Semester	
Fall Semester			
66-431 Financial Management	3	International Management Elective	3
66-473 Operations Analysis Techniques	3	66-498 Business Policy	3
General Elective	3	66-423 Marketing Management	3
General Elective	3	66-472 Organizational Development	3
Area II Elective	3	General Elective	3
	15		15

#Core requirements will differ for members of the class of 1987 and subsequent classes.

Industrial Management Program

The industrial management curriculum combines the elements of a program in operations management with a basic foundation in engineering. The first two years provide a sound education in English, mathematics, the physical sciences, mechanical engineering, economics, accounting, and statistics. The junior and senior years are devoted to professional business courses. The Industrial Management graduate is equipped to assume managerial and administrative responsibilities in technologically-oriented firms through the management of complex production activities or the marketing of specialized mechanical or electrical equipment.

COURSE OF STUDY FOR INDUSTRIAL MANAGEMENT

Freshman Year

Fall Semester		Spring Semester	
64-201 Economics I	3	64-202 Economics II	3
42-101 College Writing	3	42-102 College Writing	3
92-131 Calculus B-I	4	92-132 Calculus B-II	4
22-201 Graphics	1	95-202 Principles of Physics II	3
95-201 Principles of Physics I	3	96-202 Principles of Experimental Physics II	1
96-201 Principles of Experimental Physics I		39-200 Physical Education	1
39-100 Physical Education	1		15
	16		

Sophomore Year

Fall Semester		Spring Semester	
60-201 Accounting I	3	60-202 Accounting II	3
84-121 Chemical Principles	3	84-122 Chemical Principles	3
84-123 Chemical Principles Lab.	1	84-124 Chemical Principles Lab.	1
92-213 Calculus B-III	4	64-212 Statistics II	3
22-171 Machine Tool Lab.	1	92-234 Differential Equations	3
64-211 Statistics I	3	42-224 Business Writing	3
	15		16

Junior Year

Fall Semester		Spring Semester	
66-321 Marketing Principles	3	92-242 BASIC with Business Application	3
66-331 Business Finance	3	20-476 Statistical Quality Control	3
66-371 Operations Management I	3	47-101 General Psychology	3
22-215 Analytical Mechanics I	3	64-307 Government Business and Society	3
22-295 Materials Science	2	22-216 Analytic Mechanics II	3
	14		15

Senior Year

Fall Semester		Spring Semester	
66-473 Operations Analysis Techniques	3	66-474 Cases in Operations Analysis	3
66-404 Computer Applications to Management	3	66-498 Business Policy	3
66-353 Organizational Behavior	3	22-344 Heat and Power	3
16-348 Basic Electrical Engineering Concepts or	3	Area II Elective	3
16-290 Industrial Electronics	3	International Management Elective	3
Area II Elective	3		15
	15		

Management (Course Prefix: 66)

66-200 THE BUSINESS SYSTEM

I,II(3,0)3

An overview of the world of business. Each of the functional areas of business is examined with the objective of familiarizing the student with the role of the business system in the American economy. Credit not given toward B.S., B.A. or B.S.I.M. degrees in the College of Management Science.

66-321 MARKETING PRINCIPLES

I(3,0)3

The role of marketing in the economy. The elements of the marketing mix—product, price, distribution, and promotion—are discussed in the context of social and political constraints on marketing activity. Prerequisite: 64-201.

66-324 INDUSTRIAL MARKETING

II(3,0)3

Special problems in marketing industrial goods. Distribution channels, pricing policies product line planning and

promotional strategy for companies marketing to industrial firms, governmental agencies and other organizations. Prerequisite: 66-321.

66-325 MARKETING COMMUNICATIONS I(3,0)3
Analysis of options available to the firm in communicating to its publics. Examination of the promotional mix including advertising, personal selling, sales promotion and publicity. Prerequisite: 66-321. Credit not given to students who have taken 66-427.

66-326 MARKETING RESEARCH II(3,0)3
Analysis of the information gathering function of marketing management. Design, execution and evaluation of marketing research. Credit not given to students who have taken 66-356. Prerequisites: 66-321, 64-211.

66-331 SBUSINESS FINANCE I,II(3,0)3
Principles of financial management, including working and fixed capital, sources of funds, financial statements, budgeting and capitalization. Prerequisites: 60-202, 64-201, 64-202.

66-332 MONEY AND BANKING II(3,0)3
Evolution of money and credit and their role in the economy. Monetary policy and the Federal Reserve System. Structure and function of the commercial banking system and the role of other financial institutions. Prerequisites: 64-201, 64-202.

66-333 MULTINATIONAL MONEY AND BANKING I(3,0)3
The international banking function, including correspondent relationships between domestic and foreign banking institutions. The international money market. Prerequisite: 64-201, 64-202.

66-353 ORGANIZATIONAL BEHAVIOR I,II(3,0)3
Application of concepts from the behavioral and social sciences to individual and group activity in organizations. Use of behavioral concepts to introduce and implement organizational change. Prerequisites: 47-101, 48-101.

66-356 DBUSINESS RESEARCH METHODS I(3,0)3
Examination of various research tools applicable to problems in human resource management and to other management disciplines. Credit not given for students who have taken 66-326. Prerequisites: 66-253 and 64-211.

66-371 OPERATIONS MANAGEMENT I(3,0)3
Principles of production/operations management. Nature and function of production systems; operational planning and control; plant layout; materials handling; inventory and quality control. Prerequisite: 64-211.

66-372 OPERATIONS PLANNING AND CONTROL II(3,0)3
Cases on the application of principles from 66-371 to problems involving continuous, intermittent and job lot production systems for both small and large firms. Prerequisite: 66-371.

66-402 INTERNATIONAL BUSINESS I(3,0)3
Special problems of overseas operations of American firms. Financial, marketing, personnel and legal problems of the multinational enterprise. State trading, economic integration and international regulatory agencies. Prerequisites: 66-321, 64-202.

66-403 COMPARATIVE MANAGEMENT I(3,0)3
Management systems in different national, functional, and institutional settings. The impact of economic, social, political, and cultural variables on management styles. Prerequisites: 64-202, 66-402.

66-404 COMPUTER APPLICATIONS TO MANAGEMENT I(3,0)3
Use of computers as a tool for improving management decisions. Management problems and cases will be analyzed using the University's computer. Prerequisite: 92-242.

66-405 U.S. BUSINESS AND THE CENTRALLY PLANNED ECONOMY II(3,0)3
Special issues associated with business relations with organizations in non-market economies. The role played by central planning bodies in export and import decisions. Prerequisite: Senior standing or permission of instructor.

66-421 PURCHASING AND MATERIALS MANAGEMENT II(3,0)3
Purchasing procedures, inventory control, quality control, source selection, forward buying and speculation for the production enterprise. Prerequisite: 66-321 or permission of instructor.

- 66-422 RETAILING I,II(3,0)3
Development, organization and management of various types of retailing institutions. Evaluation of retail locations and contemporary retailing problems. Prerequisite: 66-321 or permission of instructor.
- 66-423 MARKETING MANAGEMENT II(3,0)3
Formulation, implementation and control of the firm's marketing strategies and plans. Case study of the behavioral, quantitative and environmental aspects of marketing decision-making. Prerequisites: 66-321 and 66-326 or permission of instructor.
- 66-424 MARKETING STRATEGY AND PLANNING II(3,0)3
Cases in the formulation of marketing strategy and the nature of the planning process. Prerequisite: 66-423.
- 66-425 CONSUMER BEHAVIOR II(3,0)3
Application of theories and techniques from the behavioral sciences to the understanding of consumer problem identification and purchasing processes. Prerequisites: 47-101, 48-101, 66-321.
- 66-426 SALES MANAGEMENT I(3,0)3
Management of the personal selling function. Principles of sales force organization, selection, training, compensation, supervision and motivation are explored via appropriate cases. Prerequisite: 66-321.
- 66-427 MULTINATIONAL ADVERTISING II(3,0)3
Issues and problems in international advertising; selection and use of media, translation and socio-cultural problems, international advertising agencies. Prerequisite: 66-321. Credit will not be given to students who have taken 66-325.
- 66-428 INTERNATIONAL MARKETING II(3,0)3
The marketing aspect of international business. Cultural dynamics, economics, political and legal constraints as they affect international marketing institutions and practices. Prerequisite: 66-321.
- 66-429 SPECIAL TOPICS IN MARKETING I,II(3,0)3
A seminar course which will examine in depth a topic of current interest in marketing; subject matter to be announced in advance. Prerequisite: 66-321, and permission of instructor.
- 66-431 FINANCIAL MANAGEMENT I(3,0)3
Advanced study of principles of financial management. Emphasis on case analysis and financial problem solving. Prerequisites: 66-331, 66-332, or permission of instructor.
- 66-432 FINANCIAL INSTITUTIONS AND MARKETS II(3,0)3
Theoretical and pragmatic aspects of the financial process in the economic system. Analysis of financial intermediation. Prerequisites: 66-331, 66-332.
- 66-433 PROBLEMS IN FINANCE I,II(3,0)3
Seminar in special financial topics. Prerequisites: 66-331, 66-332, and permission of instructor.
- 66-434 INVESTMENT MANAGEMENT II(3,0)3
Principles of investment: security analysis, portfolio management, market analysis. Prerequisite: 66-331.
- 66-435 INTERNATIONAL FINANCIAL INSTITUTIONS AND MARKETS
The financial intermediation function in the international economy. Prerequisite: 66-331.
- 66-438 INTERNATIONAL FINANCE II(3,0)3
Financial aspects of international business operations. Evaluation of risks associated with multinational operation and managerial decision-making under conditions of financial uncertainty. Prerequisite: 66-331.
- 66-451 PERSONNEL MANAGEMENT I(3,0)3
Recruitment, selection and training of the work force. Wage and salary administration, employee health and safety, welfare and education. Prerequisite: 66-353.
- 66-452 INDUSTRIAL RELATIONS II(3,0)3
Human interaction and group behavior in organized industrial settings. Union-management relations, grievance procedures, collective bargaining, and arbitration. Prerequisite: 66-353, 66-451.

- 66-453 MANAGEMENT AND CONTEMPORARY SOCIETY** I(3,0)3
 Role of the manager in the organization and in the greater society. Impact of the dynamic social, economic, political and cultural environment on the practice of management. Topics such as social responsibility and business ethics are investigated. Prerequisite: 66-353.
- 66-455 COMPENSATION MANAGEMENT** I(3,0)3
 A study of monetary and non-monetary compensation theories and practices in production and service organizations in both public and private sectors. Individual and team research in analyzing and comparing existing compensation systems. Prerequisites: 66-353 and senior standing, or 66-353 and consent of the instructor.
- 66-457 PROBLEMS IN HUMAN RESOURCE MANAGEMENT** I(3,0)3
 Integration and application of student's skills and knowledge in personnel management, industrial relations and other phases of human resource management. Individual and team research on selected projects involving both profit-oriented and non-profit enterprises. Prerequisites: senior standing, 66-452.
- 66-472 ORGANIZATIONAL DEVELOPMENT** II(3,0)3
 Planned organizational change using the theory and technology of applied behavioral science. Intervention strategies at the individual, group and organizational levels are explored. Prerequisite: 66-353.
- 66-473 OPERATIONS ANALYSIS TECHNIQUES** I(3,0)3
 Operations research techniques useful in managerial decision making. Mathematical programming, queuing theory, Markov processes and simulation methods. Prerequisites: 66-371, 92-242.
- 66-474 CASES IN OPERATION ANALYSIS** II(3,0)3
 Application of techniques from operations research to cases in management decision making including scheduling, inventory control and facilities design. Prerequisites: 66-473 or 92-381, 92-242.
- 66-475 SYSTEMS ANALYSIS** II(3,0)3
 The tools of systems analysis and design. Practical problems in data structures and file management will be run on the University's computer. Prerequisite: 66-404.
- 66-477 INFORMATION SYSTEMS MANAGEMENT** II(3,0)3
 Analysis and design of information systems for management planning and control. Prerequisite: 66-475. If taken, credit will not be given for 91-301 or 91-302.
- 66-478 PROBLEMS IN INFORMATION SYSTEMS** II(3,0)3
 Practice in establishment and evaluation of management information systems. Case analyses from local organizations and business firms. Prerequisite: permission of instructor.
- 66-481 RISK MANAGEMENT AND INSURANCE** I(3,0)3
 Analysis of pure risks of economic loss and evaluation of various methods of dealing with risk. Development and implementation of risk management programs for the business firm.
- 66-492 PHYSICAL DISTRIBUTION MANAGEMENT** I(3,0)3
 Social and economic aspects of transportation problems as revealed by analysis of the nature, history, and problems of the American transportation industry. Management of the distribution function: warehousing, inventory control, materials handling and industrial packaging. Prerequisites: 66-371 and 66-321.
- 66-493 MULTINATIONAL BUSINESS POLICY** II(3,0)3
 An integration of knowledge in various functional areas of management toward solution of problems affecting the character and success of the total enterprise in an international setting. Setting corporate strategy in the global context and its implementation via appropriate policies. Satisfies requirement for 66-498. Prerequisite: Graduating senior status.
- 66-494 FOREIGN AREA ANALYSIS** I,II(3,0)3
 Independent study to acquire an in-depth understanding of business conditions, sources of secondary data, etc. for a selected foreign area. Prerequisite: Graduating senior status, or permission of instructor.
- 66-495 SMALL BUSINESS PRACTICUM** I,II(3,0)3
 Practical experience in the identification and solution of management problems in smaller business in the Merrimack Valley and Greater Boston. Offered in cooperation with U.S. Small Business Administration. Prerequisite: Senior status and permission of program coordinator.

66-497 HONORS PROSEMINAR**I,II(3,0)3**

Preparation and defense of senior honors thesis in area of concentration. Prerequisite: Permission of Honors Program Coordinator.

66-498 BUSINESS POLICY**I,II(3,0)3**

An integration of knowledge in the various functional areas of management toward solution of problems affecting the character and success of the total enterprise. Corporate strategy and its implementation via appropriate policies. Prerequisite: Graduating senior status.

66-499 RESEARCH SEMINAR**I,II(3,0)3**

An opportunity for the advanced student to perform substantive research in an area for special interest under the supervision of a member of the Management faculty. Prerequisite: Permission of Department Chairman. This course may be used as a concentration elective. It may also be used to offer topics to individual students where there are an insufficient number of registrants for a regular class.

FACULTY OF THE COLLEGE OF MANAGEMENT SCIENCE**DEAN OF THE COLLEGE**

Benjamin Chinitz, B.A., M.A., Ph.D.

Joseph Thomas, B.S., M.M.S., M.P.A., D.P.A., Assistant Dean.

DEPARTMENT CHAIRMEN

Charles F. Feeney, B.S.; M.B.A.; M.S.T.; C.P.A.; Accounting

Brackston Hinchey, A.B.; M.A.; Ph.D.; Management

Paul E. Snoonian, B.S.; M.B.A.; M.A.; Ph.D.; Economics

RESIDENT FACULTY

Jack D. Alexander, Associate Professor, Management; B.S., University of Notre Dame; M.B.A., Harvard University; M.A.; Ph.D.; University of Notre Dame.

Harvey M.J. Ames, Instructor, Management; B.A., M.B.A., University of Colorado.

William J. Burke, Professor, Accounting; B.A., University of Massachusetts; M.Ed., Boston State College; J.D., Suffolk University.

Clairmont P. Carter, Professor, Accounting; B.S., Pennsylvania State University; M.B.A., University of Akron; D.B.A., Kent State University.

Albert M. Cederlund, Associate Professor, Economics; A.B., Clark University; M.S., Columbia University; Ph.D.; Clark University.

Samuel Chesler, Assistant Professor, Accounting; B.S., Boston University; M.B.A., Suffolk University.

Benjamin Chinitz, Professor, Economics; B.A., Yeshiva University; M.A., Boston University; Ph.D., Harvard University.

Leslie M. Dawson, Professor, Management; B.B.A., Iona College; M.A., University of Toledo; Ph.D., Michigan State University.

George C. Dery, Associate Professor, Economics; A.B., Merrimack College; M.A., Boston College.

Daniel E. Diamond, Professor, Economics; A.B., University of Massachusetts; M.B.A., Boston University; Ph.D., New York University.

Gerald F. Downey, Professor, Accounting; B.S., M.B.A., Northeastern University; M.A., Ph.D., Boston College.

Charles F. Feeney, Professor, Accounting; B.S., Boston College; M.B.A., Northeastern University; M.S.T., Bentley College; C.P.A., Massachusetts.

Stuart C. Freedman, Assistant Professor, Management; B.A., City University of New York; M.S., Ph.D., Cornell University.

Susan A. Goodwin, Associate Professor, Economics; B.A., Wellesley College; M.A., Boston University; Ph.D., Tufts University.

John G. Hamer, Instructor, Accounting; B.S., University of Lowell; M.B.A., Texas A & M.

Brook Hargreaves-Heald, Assistant Professor, Accounting; B.A., Brandeis University; J.D., Northeastern University.

Richard C. Healy, Jr., Associate Professor, Economics; B.S., American International College; M.A., University of Massachusetts.

Brackston Hinchey, Associate Professor, Management; A.B., M.A., Ph.D., University of Missouri.

Bhagwat Jaiman, Instructor, Management; B.S., Delhi University; M.S., Indiana University.

Daniel J. Jones, Assistant Professor, Accounting; B.A., B.S.M.E., University of Notre Dame; M.B.A., Harvard Business School; M.S., Bentley College.

Russell R. Karl, Associate Professor, Accounting; B.S., Bryant College; M.S., Suffolk Law School.

M. Riaz Khan, Associate Professor, Management; B.S., M.S., University of Karachi; M.A., M.B.A., Ph.D., State University of New York (Buffalo).

Linda H. Kistler, Professor, Accounting; B.S., M.S., Colorado State University; C.P.A., Massachusetts.

Edith M. Lang, Assistant Professor, Economics; A.B., Brooklyn College; M.A., Ph.D., University of Rochester.

Goang-Tzer Liaw, Associate Professor, Management; B.A., National Taiwan University; M.A., University of Minnesota; Ph.D., University of Illinois.

Thomas G. Macbeth, Professor, Economics; A.B., Cornell University; M.A., Ph.D., University of Southern California.

Stuart L. Mandell, Commonwealth Professor, Management; B.A., Brooklyn College; M.B.A., Syracuse University.

Carol C. McDonough, Professor, Economics; B.A., Marymount Manhattan College; M.A., Ph.D., Boston College.

James P. Monahan, Associate Professor, Management; B.S., B.A., Boston College; Ph.D., Columbia University.

George E. Nogler, Assistant Professor, Accounting; B.S.A., Bentley College; M.A., Assumption College; M.B.A., Boston University; C.P.A., Massachusetts.

Santo J. Pullara, Professor, Management; B.S., M.B.A., J.D., Ph.D., Syracuse University.

Yash R. Puri, Associate Professor, Management; B.S., M.S., M.B.A., Delhi University; M.B.A., Ph.D., Indiana University.

Rosanne M. Riddick, Assistant Professor, Accounting; B.A., Yale University; M.S. in Accounting, Northeastern University; C.P.A., Massachusetts.

Ralph A. Rieth, Jr., Assistant Professor, Management; B.S., Northeastern University; M.B.A., New York University; J.D., Howard University; Ph.D., University of Iowa.

Charles L. Saccardo, Assistant Professor, Economics; B.S., Northeastern University; M.A., Georgetown University.

Ernesto Sanz, Assistant Professor, Economics; B.A., Loyola University (Spain); M.A., Kamakura Language College (Japan); M.A., Sophia University (Japan); Ph.D., Boston College.

Irwin A. Shapiro, Associate Professor, Management; B.S., Syracuse University; M.B.A., Indiana University; M.A., Ph.D., Clark University.

Balbir S. Sihag, Assistant Professor, Economics; B.A., Dayanand College, India; M.A., Panjas University, India; Ph.D., Massachusetts Institute of Technology.

Paul E. Snoonian, Associate Professor, Economics; B.S., M.B.A., Northeastern University; M.A., Ph.D., Michigan State University.

F. Joseph Thomas, Assistant Professor, Management; B.S., U.S. Naval Academy; M.M.S., Lowell Technological Institute; M.P.A., D.P.A., Nova University.

Charles F. Thompson, Assistant Professor, Accounting; B.S.A., Bentley College; M.B.A., Northeastern University; C.P.A., Massachusetts.

George J. Toscano, Professor (Emeritus), Accounting; B.S., M.B.A., Northeastern University; C.P.A., Massachusetts.

Louis E. Yelle, Associate Professor, Management; B.S., Lowell Technological Institute; M.S., M.B.A., Northeastern University.

James A. Zeitler, Instructor, Economics; B.A., Gannon College.

COLLEGE OF MUSIC

It is the philosophy of the College of Music that every graduate, regardless of area of concentration or personal goal, must be both an educated person and a qualified musician. The study of music involves the development of the intellect, the acquisition of an aesthetic and philosophical comprehension of the art of music, and, in the case of recipients of professional degrees, a high level of proficiency in a chosen performance medium. The particular degree program which a student may select will depend, of course, upon his or her personal objectives and individual competencies. The Bachelor of Music programs are professional in nature and seek to develop that high degree of musicianship which is fundamental to creative, scholarly and educational practice in music. The Bachelor of Arts program, on the other hand, is appropriate for students with a general interest in music, or with interests in other academic disciplines as well as music.

OBJECTIVES OF THE COLLEGE OF MUSIC

The objectives of the College of Music are to provide each student with the opportunity to master the fundamental knowledge upon which all music is based, to obtain the special and technical knowledge related to one or more of the various branches of music, to develop an understanding and an appreciation of the cultural and social heritage of musical experience, and to appreciate that one's personal education is a lifetime process to be pursued in both formal and informal environments. The faculty of the College of Music believe that each recipient of a baccalaureate degree in music, regardless of personal goal, should be a qualified musician, and it is to this end that all undergraduate programs are directed. Additionally, the program in music education seeks to prepare professional personnel for teaching and leadership positions in a variety of educational levels, to contribute to the development of institutional organizations, arrangements, and service systems concerned with the teaching of music, and to provide leadership in effecting planned change in music programs at all levels of public education.

COLLEGE ORGANIZATION AND GOVERNANCE

The College of Music is organized into three departments and is administered by a Dean. Each department is responsible for developing its course offerings and programs of study, and the music faculty, as a whole, is responsible for academic policies. The Academic Standards Committee has oversight of the College's academic standards and serves as a review body for the readmission of suspended students. A Curriculum Committee monitors curricular matters and submits its recommendations to the full faculty for final determination. Specific matters pertaining to subdisciplines in music are referred to the appropriate department and/or faculty.

ACADEMIC STANDARDS COMMITTEE

HEADS OF MUSIC AREAS

Thomas G. Elliot
Paul L. Gayzagian
Antone S. Holevas
John K. Ogasapian
Willis Traphagan

Everett Beale, Percussion
Dean Bouzianis, Theory
Donald Bravo, Woodwinds
Calvin Lindblad, Keyboard
Ivan Oak, Voice
John Ogasapian, Music History
Natalo Paella, Brass
Kay Roberts, Strings

BACCALAUREATE DEGREE PROGRAMS

The College of Music offers undergraduate programs leading to the degree of Bachelor of Arts and to the professional degree of Bachelor of Music. For details concerning graduate music programs, see the *Graduate School Catalogue*.

Bachelor of Arts Degree

The Bachelor of Arts degree is intended for the student who has a general interest in music and wishes to secure a broad, comprehensive education or desires to combine his or her music studies with some other major or minor academic field. The requirements for majors are set by university departments but must specify a minimum of 30 semester credits. Although students may not be required to take more than 45 semester credits in the major field,

they may elect to take additional courses in the major field beyond the specified required maximum. At least 15 credits in the major field must be taken at the upperdivision course level. Bachelor of Arts degree programs require a minimum of 75 semester credits outside the major field, except as specified by provisions concerning second majors.

Music majors who are candidates for the Bachelor of Arts degree in the College of Music may elect a second major which is offered by other colleges of the University. Students who elect academic majors in more than one college are candidates for one degree only, and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary at the time they make a declaration of second major by filing for intercollegiate transfer. Accordingly, a student who pursues a music major in the College of Music and a second major in another college is subject to all degree requirements as specified by the College of Music and is subject only to major course requirements (including any collateral and prerequisite courses for the major) as specified by the department of his or her second major. For a full discussion of University requirements concerning second majors, student should consult the applicable section of this publication which appears under the heading "Academic Policies."

In accordance with the requirements of established minor programs, music majors who matriculate for the degree of Bachelor of Arts may undertake a minor which is offered by another college of the University. Students who are interested in such programs should refer to the appropriate chapters which detail the programs of other colleges.

Music majors who do not desire second majors or minor programs may complete their Bachelor of Arts requirements through a program of elective courses. Such elective programs may not be taken in the College of Music and must be approved by the student's faculty advisor. When presented in fulfillment of collateral degree requirements without a second major or a minor, the program of elective courses must include at least 6 credits of courses which are on or above the 300 course level.

Bachelor of Music Degree

The Bachelor of Music degree is offered in seven areas of specialization: music education, music history and literature, music theory and composition, performance, jazz studies, recording technology, music and business. The music education specialization is designed to prepare teachers and supervisors of music in the elementary and secondary schools. The specializations in music history and literature, music theory and composition, and performance provide abundant opportunities for individual performance, research and creativity to students who wish professional careers in music. Programs combining two areas of specialization, e.g., music education/performance, are also available. A student desiring to pursue such a combined course of study must satisfy the requirements in both areas and should plan to spend one or more semesters in residence beyond the normal eight semesters of full-time study which are required for the successful completion of a program with a single area of specialization.

Individual and group performances are important aspects of all Bachelor of Music programs, *but students in the performance specialization are required to demonstrate outstanding ability as performers in order to satisfy admission and retention standards.* Students specializing in music history and literature and in music theory and composition must demonstrate similar outstanding abilities in their chosen fields in order to satisfy admission and retention standards. Students preparing for admission to the music education specialization are required to select applied music courses each semester for maintaining and developing their music skills, and they are expected to develop minimum standards of performance in piano and in their areas of performance emphasis. The music education specialization is subject to the same rules and regulations as those which govern all teacher education programs of the University.

All Bachelor of Music candidates must participate in one or more ensembles during each semester of their residence, unless otherwise specified. All Bachelor of Music candidates are expected to reach a level of proficiency in their performance medium which merits faculty permission to perform in public recital.

GENERAL COLLEGE REQUIREMENTS

In order to qualify for a baccalaureate degree offered by the College of Music, undergraduates must comply with the University Core Requirements, must conform to the rules of the College of Music which govern degrees and

major studies for such degrees, and must earn a 2.00 average in their major concentrations or specializations by the end of the senior year. (Additional requirements are specified for retention in the music education program.) Students who have failed to achieve a 2.00 average in their major concentrations or specializations by the end of the junior year have not made satisfactory progress toward their degrees, and upon the recommendation of appropriate departmental committees and the concurrence of the Academic Standards Committee of the College, such students may be placed on probationary status in the College or dismissed from the University for inadequate scholarship.

Language Proficiency

The College of Music does not specify a level of language proficiency as a formal requirement for degrees; however, students who anticipate graduate work in such areas as music history and literature are encouraged to develop proficiency during their undergraduate enrollment. Students who desire to present official evidency of language proficiency for purposes of employment or application to graduate school should consult policies listed elsewhere in this publication under the heading "Academic Policies: Language Requirement" for a listing of avenues by which certification of language proficiency may be pursued.

Declaration of Major

Students enrolled in the College of Music of necessity are committed to pursue one of the established music programs. Admission to major specializations of the Bachelor of Music degree is governed by specific achievement standards which are described under the several specialization headings. In any event, all students are required to file specific declarations of major with the Office of the Registrar no later than the beginning of their junior year. Students enrolled in other colleges who wish to elect a second major in music which is offered by the college under requirements for the Bachelor of Arts degree must secure the approval of the chairperson of the Department of Academic Studies prior to making such a declaration and must file the appropriate University form with the Office of the Registrar no later than the end of the freshman year.

Change of Major

Bachelor of Arts degree candidates in the College of Music may not drop the music major without withdrawing from the University, transferring to another college of the University, or changing their degree program in the College. Students who wish to change their major from music to another major must file for intercollegiate transfer within the University. (Cf. below.) Students who wish to make a change of program from the Bachelor of Arts to the Bachelor of Music degree must secure the approval of the appropriate Chairperson. All such changes of program require that the form for declaration of major or change of major be filed with the Office of the Registrar. Students who are candidates for the Bachelor of Music degree may change their areas of specialization when they have received the permission of the appropriate Chairperson.

Transfer Policies

Students transferring to the College of Music from other colleges of the University or from other institutions may expect recognition of previously completed courses if these are equivalent to those which are specified by curricula of the College. Students who wish to apply for transfer or for intercollegiate transfer to the College of Music are required to achieve satisfactory scores on written tests of musical aptitude and basic music theory which are developed and administered by the College of Music. Students wishing to transfer to Bachelor of Music programs are required to demonstrate their vocal or instrumental ability during a jury examination before a committee of the faculty of the College.

Transfer from other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University requirements. In addition, courses which are presented for transfer are evaluated by professional departments in terms of college and program requirements at the time a student is accepted for matricula-

tion in the College of Music. Courses which are transferred to the University under provisions of the Massachusetts Transfer Compact and which are not creditable to requirements of the College of Music or as unrestricted elective courses will be listed on the student's permanent record card but will not apply to the minimum degree requirements. In the event that a student who has been transferred to the University under the Massachusetts Transfer Compact subsequently makes an intercollegiate transfer to the College of Music, all previously completed courses, including transferred courses from the compact institution, will be reevaluated in terms of their applicability to degree requirements of the College of Music.

Repetition of Transferred Courses

A student who has been granted transfer credit, and on that basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form with the office of the College dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Music

Students wishing to transfer from another college of the University must file a petition, together with a transcript of their permanent record cards, with the appropriate department chairperson and the Dean of the College of Music by November 1 for spring semester and by April 1 for fall semester transfer. Students are referred to University policies concerning intercollegiate transfer which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Office of the Dean and, irrespective of grades previously received in other college programs, all courses which may not be applied to college or program requirements are deleted from the student's cumulative grade-point average.

Ordinarily, students may not transfer into programs of the Bachelor of Music degree from other programs of the University; however, such transfer may be permitted for the unusually gifted student early in his or her academic career. Students who make such a transfer may expect to extend their period of study beyond the normal eight semesters.

Applied Music

All students other than performance majors must successfully complete eight semesters of applied music on their principal instrument, earning no less than 16 credits toward graduation. An evaluation by faculty panel is normally required at the conclusion of the 2nd and 5th semesters of applied study. Additional panel evaluations may be required at the discretion of the appropriate applied Coordinator. For performance majors, the 5th semester panel evaluation may also serve as a recital permission evaluation. In all cases, the panel evaluation grade will be averaged with the studio grade to compute the final semester grade. (The performance specialization requires eight semesters of study and a total of 23 credits in applied music.)

Student Recitals

Students in the Performance Major Specialization are required to present a Senior Recital, normally accomplished while enrolled in Performance Applied VI. In addition, keyboard majors are required to participate in a Chamber Music Recital while enrolled in 76-159. Students may petition the Department Chairperson for permission to present the Senior Recital one semester early, during Performance Applied V. Students in other specializations may also present public recitals. In all cases, students wishing to present a recital must receive recital permission from the Applied Instructor, the appropriate Applied Coordinator and the Chairperson of the Performance Department. A Recital Permission Form may be obtained at the music office, and must be submitted no later than November 15 in the fall semester and March 15 in the spring semester.

Ensemble Requirements

Students whose major areas of performance are *voice, brass, wind, string and percussion* must participate satisfactorily in the major ensemble program of their area, earning a minimum of sixteen credits as required by their specialization, and must participate in the ensemble program during each semester of residence, regardless of total credits accrued. Under some circumstances, students may petition the Chairperson of the Department of Performance for permission to substitute music electives as partial fulfillment of the ensemble requirement. Under no circumstances may such a student earn less than twelve ensemble credits.

DEPARTMENT OF ACADEMIC STUDIES

Antone Holevas, Chairperson

Professors: John Ogasapian, Domenic Procopio

Associate Professors: Jacqueline Charette, Paul Gay, Antone Holevas, W. Anne Trenkamp

Assistant Professors: Dean Bouzianis, Alma Espinosa

In cooperation with the Department of Performance, the Department of Academic Studies offers a major in music which leads to the Bachelor of Arts degree, and Bachelor of Music degree specializations in music history and literature, and music theory and composition. The Department also offers a minor area of study in music history and literature.

Music Major (Bachelor of Arts)

Students interested in the Bachelor of Arts program must make formal application to the Department Chairperson between December 1 and May 1. Students applying to this program should evidence superior academic promise. Applicants will be accepted by vote of the full faculty of the Department.

Music majors who matriculate for the degree of Bachelor of Arts must take 30-45 credits of course work in music.

The following courses must be completed by all candidates for the Bachelor of Arts degree:

Harmony I, II, III, 71-101, 71-102, 71-201.

Form and Analysis 71-300.

Survey of Music History I, II 74-261, 74-262.

The remaining courses of the major, up to a maximum of 45 credits,* may be selected from the offerings of the College of Music, the following courses of which are recommended:

71-336 Vocal Arranging

71-450 Pedagogy of Theory

71-310 20th Century Theory

71-402 18th Century Counterpoint

71-405 Orchestration

71-407 Electronic Music

74-363 History of Choral Music

74-364 History of Opera

74-365 The Concerto

74-366 The Symphony

74-461 Music of the Middle Ages

74-462 Music of the Renaissance

74-463 Music of the Baroque

74-464 Music of the Classic

74-465 Music of the Romantic

74-466 Twentieth Century Music

74-367 Origins of Jazz

74-368 The American Popular Song

*Students who elect to take more than 45 credits in music may not reduce the requirement of 75 credits outside the major. Music majors who elect a second major in another academic field may not count more than 63 credits in the two majors combined toward the minimum degree requirement of 120 credits.

Music History and Literature (Bachelor of Music)

Students who are interested in the program for Music History and Literature must make formal application to the Chairperson of the Music History Committee between December 1 and May 1 of their sophomore year. Students applying to this program should evidence superior promise in the area. Applicants will be accepted by vote of the committee.

Acceptance will be based on the following criteria:

1. An overall 2.5 cumulative in all courses;
2. A grade of at least 2.5 in College Writing (42-101, 42-102);
3. A cumulative average of at least 2.5 in freshman and sophomore Harmony (71-101, 71-102, 72-201) and Solfege (71-103, 71-104, 71-203);
4. A grade of 3.0 or better in Survey of Music History (74-261).

Upon acceptance in the area, the student is required to file a form for declaration of major with the Office of the Registrar. The appropriate form may be obtained from the Registrar and must be returned to this office after the required signatures have been obtained through the Chairperson of the Department of Academic Studies.

Students transferring to the College and wishing to specialize in the area of Music History and Literature must comply with the requirements for admission to this degree program in the College of Music and must satisfy the basic music course requirement, either through lower level courses in the College of Music or through courses taken at another institution of higher learning.

Students in Music History and Literature must complete a thesis during their senior year. The thesis must demonstrate ability to do formal research at a basic level and to organize and present the results of that research in proper form. The thesis is undertaken as a part of 74-469 Musicology and Research, and is directed by a member of the Music History faculty.

COURSE OF STUDY FOR MUSIC HISTORY AND LITERATURE SPECIALIZATION*

Freshman				Year					
Fall Semester		Area Preference		Spring Semester		Area Preference			
		V	K	O		V	K	O	
71-101	Theory I	2	2	2	71-102	Theory II	3	3	3
71-103	Aural and Visual Perception I	3	3	3	71-104	Aural and Visual Percept. II	2	2	2
72-	Applied Music I	2	2	2	72-	Applied Music II	2	2	2
76-	Ensemble	2	2	2	76-	Ensemble	2	2	
72-131	Introduction to Keyboard	1		1	72-132	Introduction to Keyboard	1		1
72-133	Keyboard Accompanying	1			72-134	Keyboard Accompanying		1	
42-101	College Writing	3	3	3	42-102	College Writing	3	3	3
	UCR	3	3	3		UCR	3	3	3
39-101	Physical Education	1	1	1	39-102	Physical Education	1	1	1
		17	17	17			17	17	17
Sophomore Year									
Fall Semester				Spring Semester					
71-201	Theory III	3	3	3	71-300	Form & Analysis	3	3	3
72-	Applied Music III	2	2	2	72-	Applied Music IV	2	2	2
76-	Ensemble	2	2	2	76-	Ensemble	2	2	2
74-261	Survey of Music					UCR	3	3	3
	History I	3	3	3		Music Elective	2	2	2
	Music Elective	2	2	2	74-262	Survey of Music			
	UCR	3	3	3		History II	3	3	3
		15	15	15			15	15	15
Junior Year									
Fall Semester				Spring Semester					
74-361	Music of the Middle Ages	3	3	3	74-363	Music of the Baroque	3	3	3
74-362	Music of the Renaissance	3	3	3	72-364	Music of the Classic	3	3	3
72-	Applied Music V	2	2	2					
76-	Ensemble	2	2	2		UCR	3	3	3
	UCR	3	3	3		Music Theory Elective	3	3	3
	Music Theory Elective	3	3	3	75-234	Conducting II	1	1	1
75-233	Conducting I	1	1	1					
		17	17	17			17	17	17
Senior Year									
Fall Semester				Spring Semester					
74-364	Music of the Romantic	3	3	3	74-366	Music of the 20th Century	3	3	3
74-468	Musicology & Research I	3	3	3	74-469	Musicology & Research II	3	3	3
72-	Applied Music VII	2	2	2	72-	Applied Music VIII	2	2	2
76-	Ensemble	2	2	2	72-	Applied Music VIII	2	2	2
	UCR	6	6	6		UCR	3	3	3
	Music Elective	2	2	2		Music Elective	2	2	2
		18	18	18			15	15	15

*Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Music Theory and Composition (Bachelor of Music)

Students who are interested in the program for Music Theory and Composition must make formal application to the Chairperson of the Music Theory Committee, between December 1 and May 1 of their sophomore year. Students applying for admission to this program should evidence superior promise in the area. Acceptance will be predicted on the following criteria: (1) a cumulative average of 3.0 in freshman and sophomore Harmony

(71-101, 71-102, 71-201) and Solfege (71-103, 71-104, 71-203); and (2) a cumulative average of 2.5 in all music courses attempted up to the time of application.

The candidate must request a letter of evaluation from his/her instructor in the areas of Harmony and Solfege. Instructors will forward such letters to the Chairperson of the Music Theory Committee. Applicants will be accepted by vote of the committee.

Upon acceptance in the area, the student is required to file a form for declaration of major with the Registrar. The appropriate form may be obtained from the Registrar and must be returned to this office after the required signatures have been obtained through the Chairperson of the Department of Academic Studies.

Students transferring to the College and wishing to specialize in the area of Music Theory and Composition must comply with the requirements for admission to the degree program as set forth above and must satisfy the basic music course requirement, either through lower level courses of the College of Music or of another accredited institution of higher education. A student who wishes to emphasize work in the area of composition must present a public performance of at least one instrumental composition of their own, lasting six to eight minutes. This composition must be for a chamber ensemble which may or may not include keyboard and/or voice(s). The work should be representative of the candidate's ability to use more than one instrument soloistically. Acceptable media include woodwind quartet, string quartet, mixed groups of instruments, chorus with instrumental accompaniment, or brass or string ensemble. Students must make all necessary arrangements for procuring recital facilities and for rehearsing and conducting their compositions. Arrangements are to be made in consultation with the Chair, Music Theory Committee, and the student's adviser.

In addition, theory and composition majors must present to the Chairperson of the Music Theory Committee by April 25 of their senior year, a portfolio containing the following: (1) a piece for full orchestra, (2) a work for chamber ensemble, and (3) an approved piece in an optional idiom. Among the movements in the pieces submitted there should be (1) a movement in sonata form, and (2) a theme with at least five variations. Acceptance of the portfolio will be by recommendation of the instructor and one other member of the committee.

A student wishing to emphasize work in the area of pure theory, must present to the chairperson of the Music Theory Committee by April 25 of their Senior year a scholarly paper on an approved topic. Acceptance of the paper will be by recommendation of the instructor of 71-414 and one other member of the committee.

COURSE OF STUDY FOR MUSIC THEORY AND COMPOSITION SPECIALIZATION*

I			II		
Freshman Year			Spring Semester		
Fall Semester					
72-	Applied Music I	2	72-	Applied Music II	2
76-	Ensemble	2	76-	Ensemble	2
75-131	133 Keyboard Skills, Kybd. Acc.	1	75-132	134 Keyboard Skills, Kybd. Acc.	1
71-101	Theory I	2	71-102	Theory II	3
71-103	Aural and Visual Perception I	3	71-104	Aural & Visual Percept. II	2
42-101	College Writing I	3	42-102	College Writing II	3
	U.C.R.	3		U.C.R.	3
	Physical Education	1		Physical Education	1
		17			17
III			IV		
72-	Applied Music III	2	72-	Applied Music III	2
76-	Ensemble	2	76-	Ensemble	2
71-201	Theory III	3	71-310	20th Century Theory	3
71-203	Aural & Visual Perception III	2	71-204	Aural & Visual Percept. IV	2
74-261	Survey Music Hist. I	3	74-262	Survey Music Hist. II	3
75-233	Conducting I	1	71-300	Form and Analysis	3
	U.C.R.	3	75-234	Conducting II	1
		16			16
V			VI		
			Theory	Composition	
72-	Applied Music V	2	72-	Applied Music V	2
76-	Ensemble	2	76-	Ensemble	2
71-405	Orchestration	3	71-315	Comp. I Class	3
71-403	18th Cent. Counterpoint	3	71-413	Seminar: Theory D.S.	3
	Music History Elective	3		Theory Elective	3
	U.C.R.	3		M. Hist. Elec.	3
		16			16

VII				VIII			
		Theory	Composition				
72-	Applied Music VII	2	2	72-	Applied Music VIII	2	2
76-	Ensemble	3	3	76-	Ensemble	2	2
	Theory Elective	2	2	71-418	Composition III	—	3
71-415	Composition II	—	3		Theory Pedagogy	3	—
71-414	Theory Research Project	3	—		Free Elective	3	3
	Free Elective	3	3		U.C.R.	3	3
		13	13			13	13

COURSE OF STUDY FOR MUSIC WITH ELECTIVE STUDY IN BUSINESS*

Freshman Year

Fall Semester

71-103	Solfège I	3
71-101	Harmony I	2
71-131	Intro to Keyboard I	1
72	Applied Music	2
72	Ensemble	2
92-101	Pre Calculus Math (III)	3
42-101	College Writing (Plus Physical Activities)	3
		16

Spring Semester

71-104	Solfège II	2
71-102	Harmony II	3
71-132	Intro to Keyboard II	1
72	Applied Music	2
72	Ensemble	2
92-209	Intro Theory Computer Programming(III)	3
42-102	College Writing (Plus Physical Activities)	3
		16 32

Sophomore Year

Fall Semester III

71-203	Harmony III	3
72-333	Conducting I	1
72	Applied Music	2
72	Ensemble	2
74-261	Mus. Hist. & Lit. I	3
64-201	Economics I (UCR I)	3
	U.C.R. II	3
		17

Spring Semester IV

71	Form/Analysis	3
72-334	Conducting II	1
72	Applied Music	2
72	Ensemble	2
74-262	Mus. Hist. & Lit. II	3
64-202	Economics II (UCR I)	3
66	Management Elective*	3
		17 34

Junior Year

Fall Semester V

	Upper Level Mus. Elective	3
72-	Applied Music	2
72-	Ensemble	2
60-201	Accounting Principles I	3
	Mus. Bus.: Arts Management	3
	U.C.R. (III)	3
	Unrestricted Elective	3
		19

Spring Semester VI

	Upper Level Mus. Elec.	3
72-	Applied Music	2
72-	Ensemble	2
60-201	Accounting Princ. II	3
60-362	Business Law I	3
	U.C.R. (II)	3
	Survey of Music Industry	3
		19 38

Senior Year

Fall Semester VII

72	Ensemble	2
72	Applied	2
	Business Elective	3
	Seminar: Mus. Industry	3
	Unrestricted Elective	3
	U.C.R. (I, II, or III)	3
		16

Spring Semester VIII

72	Ensemble	2
72	Applied	2
	Apprenticeship	6
		10 26
	TOTAL: 130 (Plus Physical Activities)	

*Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

Music History and Literature Minor

Students matriculating for degrees in other colleges of the University and possessing a fundamental knowledge of music may pursue a minor area of study in music history and literature upon the approval of the Chairperson of the Department of Academic Studies. A minor area of study in music history and literature consists of 18-24 semester credits as approved by the Chairperson of the Music History Committee. At least 6 credits of the minor must be elected in courses at the 300 level or higher.

Music Theory & Composition (Course Prefix: 71)

71-100 PRINCIPLES OF MUSIC THEORY

I,II(3,0)3

A study of the symbolics of music and their application to the comprehension of the architectural and organizational elements of music literature. Open to non-music majors. Elliot.

71-101 MUSIC THEORY I

I(2,0)2

An intensive study of the theoretical language of music. Stresses part writing in S.A.T.B. and basso continuo realization with a free instrumental part which utilizes free voice leading relative to the use of non-harmonic activity and the harmonic principles through first and second inversion triads. Instruments of the string section are covered, and appropriate listening assignments are given. Original composition in the style being studied is required. Bouzianis/Staff.

71-102 MUSIC THEORY II

II(3,0)3

A continuation of the practices of Music Theory I relative to part writing both vocal and instrumental including secondary triads, the Neapolitan sixth, modal interchange, dominant sevenths in inversion and root position, modulation, and secondary dominants. Instrumentation covers the woodwind section, and original composition in the style being covered is required. Prerequisite: 71-102. Bouzianis/Staff.

71-103 AURAL AND VISUAL PERCEPTION I

I(3,0)3

An introduction to the techniques of translating the symbolics of music into audible sounds, and the reverse. It employs as fixed "do" system and deals with diatonic melodies in major and minor keys, intervals, fundamental beat-patterns, meter and rhythm. Literature from a variety of sources is employed, and harmonic dictation follows the sequence and progress of Theory I. Bouzianis/Staff.

71-104 AURAL AND VISUAL PERCEPTION II

II(2,0)2

A continuation of Aural and Visual Perception I requiring greater facility in the skills of perception and execution developed in the previous semester, and the mastery of additional skills required to deal intellectually with notational and musical problems encountered in more sophisticated literature. A variety of clefs, beat subdivisions, artificial divisions, modal and modulating music, jazz and blues idioms as well as an introduction to non-diatonic music literature are included in the course. Harmonic dictation throughout the semester is correlated to Theory II. Prerequisite: 71-103. Bouzianis/Staff.

71-201 MUSIC THEORY III

I(3,0)3

A continuation of the practices of Music Theory II relative to part writing both vocal and instrumental including remote modulation and satellite keys, the diminished seventh, augmented sixth, ninth, eleventh and thirteenth extensions, sequential secondary dominants and secondary sevenths. Instrumentation covers the brass section; original work in the style being covered and in various formal configurations is required. Prerequisite: 71-102. Bouzianis/Staff.

71-203 AURAL AND VISUAL PERCEPTION III

I(2,0)2

An intensive application of requisite skills to chromatic and non-diatonic music, changing and composite meters, displaced accents, cross rhythms, and a vertical approach to reading often necessary in the study of scores. Advanced tonal as well as a tonal literature is considered. Harmonic dictation continues to follow the sequence and progress of Theory III. Prerequisite: 71-104. Bouzianis/Staff.

71-204 AURAL AND VISUAL PERCEPTION IV

II(2,0)2

A concentration on the techniques employed in solving the notation and musical problems of the music of the 20th century. The considerations include synthetic and non-Western scales, pitch sets and twelve-tone serialism.

71-300 FORM AND ANALYSIS

I,II(3,0)3

A study of the structure and organizational principles of music. Prerequisite: 71-201. Trenkamp, Charette.

71-303 INSTRUMENTAL SOLFEGE

I,II(2,0)2

Designed for students who have completed Applied Music IV. Students perform individually for the instructor and class. Details of rhythm, pitch, dynamics, and basic musicianship are corrected and discussed. Prerequisite: 71-104. Gay.

71-304 THE MOVEABLE "DO" METHOD

I,II(2,0)2

A study of the system of solmization in which "do" changes as the tonal centers change. Prerequisite: 71-104. Charette.

- 71-305 JAZZ SOLFEGE** II(2,0)2
An application of the methods of solfège to the reading at sight of jazz rhythms and melody. Rhythmic and harmonic dictation of various configurations of vocal and instrumental ensembles will be covered. Prerequisite: 71-104. Holevas.
- 71-310 TWENTIETH CENTURY THEORY** I(3,0)3
A study of twentieth century music theory via a compositional approach relative to tertial, quartal, and secundo vertical sonorities, and linear combinations featuring modal and synthetic scale resources as well as serial and pre-serial atonality. Prerequisite: 71-201. Holevas.
- 71-315 COMPOSITION I CLASS** II(3,0)3
An application of various techniques of musical composition. Class compositions will be performed and critiqued. Prerequisite: 71-201, 300, 402, 405. Holevas.
- 71-318 KEYBOARD HARMONY** I,II(2,0)2
Through realization of continuo, accompaniment of melodies in a pianistic style and facility with a number of chord progressions, keyboard harmony teaches the student, in a musical setting, the basic principles of chord connection. Prerequisite: 71-201. Lindblad.
- 71-327 JAZZ ARRANGING I** I(3,0)3
A discussion of the basic concepts of arranging which include approach techniques, melodic analysis, tensions, harmonic progressions, harmonization of melodies, and four part writing. Prerequisite: 71-201. Longstreth.
- 71-328 JAZZ ARRANGING II** II(3,0)3
Discussion of tensions, alternate voicings, close and open voicings, characteristics of sectional versus ensemble arranging, writing for four saxes, four brass, and rhythm section. Arrangements will be performed. Prerequisite: 71-327. Longstreth.
- 71-336 VOCAL ARRANGING** II(3,0)3
Analysis and practical application of techniques of vocal scoring including women's voices, men's voices, and mixed voices in varied configurations and styles. Prerequisite: 71-201. Holevas.
- 71-402 EIGHTEENTH CENTURY COUNTERPOINT** II(3,0)3
An exposition of the contrapuntal practice of the period, as exemplified by the works of J.S. Bach. Specifically, the course deals with the technique of developing independent but complementary melodic lines through the ornamentation of a basic harmonic structure. Representative vocal and instrumental forms are heard and analyzed and the original idiomatic writing is required. Prerequisite: 71-201. Bouzianis.
- 71-405 ORCHESTRATION** I(3,0)3
A study of orchestral writing for the standard symphony orchestra. Emphasis on advanced instrumentation and on individual scoring projects. Prerequisite: 71-201. Holevas.
- 71-407 CONTEMPORARY TECHNIQUES** II(3,0)3
An intense study of advanced current practices in music composition, notation, and the use of special devices. Theory staff.
- 71-407 ELECTRONIC MUSIC** I(3,0)3
A study of the most recent experiments and techniques in electronic music. Composition and performance using such equipment as the synthesizer and computers. Smith.
- 71-411 SIXTEENTH CENTURY COUNTERPOINT** II(3,0)3
A study of the contrapuntal practices of the sixteenth century as exemplified by Palestrina and his contemporaries. Representative vocal forms are heard and analyzed, and original composing in the style is required. Prerequisite: 71-201. Bouzianis.
- 71-413 SEMINAR IN MUSIC THEORY** II(3,0)3
An intense study of advanced topics in music theory. Prerequisites: 71-300, 402, 405. Theory staff.
- 71-414 THEORY RESEARCH PROJECT** I(3,0)3
Limited to undergraduate theory/composition majors. Individual development of an approved topic under faculty direction. Acceptance of completed work will be by recommendation of the instructor and one other member of the Theory Committee. Prerequisite: 71-413. Permission of Chairperson required. Theory staff.

71-415 COMPOSITION II I(ARR)3
Limited to undergraduate majors in music theory/ composition. Involves individual composition, composition under the direction of faculty. Prerequisite: 71-315 Permission of Chairperson required. Holevas.

71-418 COMPOSITION III II(ARR)3
Continuation of 71-415. Prerequisite: 71-415. Permission of Chairperson required. Holevas.

71-427 JAZZ ARRANGING III I(3,0)3
A study of improvisational techniques; writing for five way sax soli, spreads, and six brass soli voicings will be stressed. Arrangements will be performed. Prerequisite: 71-328. Longstreth.

71-427 JAZZ ARRANGING IV II(3,0)3
Utilizing contemporary techniques of professional arrangements. Advanced writing for big band. Arrangements will be performed. Prerequisite: 71-427. Longstreth.

71-450 PEDAGOGY OF THEORY II(3,0)3
An examination of the principal points of view relative to tonal theory as expressed by the major theorists of the 20th century. Relative weaknesses and strengths will be examined, and students will be expected to develop their own presentation of specific topics for particular pedagogical situations. Prerequisite: 71-201.

71-495 DIRECTED STUDY IN MUSIC THEORY I,II(ARR)3
Individual work under the supervision of a member of the music theory faculty on a wide variety of topics approved by the instructor and the chairperson of the Music Theory Committee. Permission of department chairperson required. Staff.

Music History & Literature (Course Prefix: 74)

74-133 DEVELOPMENT OF JAZZ (3,0)3
An introduction to the concepts of jazz improvisation, rhythm, harmony and style. The course traces the development of jazz from the early New Orleans idiom to the avant-garde and "free" music of the 60's. Emphasis is on major jazz performers and their recorded performance. Open to non-music majors only. Mele.

74-161 MUSIC OF WESTERN CIVILIZATION (3,0)3
A survey of music from earliest times to the present. Significant forms, styles, composers and aesthetic concepts are examined. Open to non-music majors only. Espinosa.

74-200 AMERICAN MUSIC (3,0)3
A historical survey of music in the United States from colonial times to the present. Open to non-music majors only. Ogasapian.

74-166 WOMEN IN MUSIC (3,0)3
Survey of the role of women in music from ancient times to the present, with primary emphasis on composers of art music in the western tradition. Espinosa.

74-220 MUSIC IN CONCERT (3,0)3
This course introduces students to a wide variety of live performances both on and off campus. The course will emphasize concert attendance. Class sessions will be devoted to planning individual concert schedules and discussion of music to be performed. The sessions will also provide an opportunity for open discussion with guest conductors and performers. Open to non-music majors. Elliot.

74-261 SURVEY OF MUSIC HISTORY I I (3,0)3
A study of sacred and secular musical forms from pre-Christianity to 1750. Ogasapian.

74-262 SURVEY OF MUSIC HISTORY II II,(3,0)3
A study of musical forms and styles from 1750 to the present. Ogasapian.

74-367 ORIGINS OF JAZZ (3,0)3
An intense study of the history of jazz from its origins to the present, covering a wide selection of styles and schools of jazz in various ensemble configurations. Mele.

74-368 THE AMERICAN POPULAR SONG (3,0)3
A study of American popular song from 1920 to the present.

- 74-371 KEYBOARD LITERATURE (3,0)3
A survey of the literature for keyboard instruments from the fifteenth century to the present. Prerequisite: 74-261, 262. Espinosa.
- 74-363 HISTORY OF CHORAL MUSIC (3,0)3
A study of the stylistic and compositional approaches to choral music from Ockeghem to Stravinsky. Prerequisite: 74-261, 262. White.
- 74-364 HISTORY OF OPERA (3,0)3
The development of opera and musical drama from its origins to the present is examined in some detail. Prerequisite: 75-261, 262. White.
- 74-365 THE CONCERTO (3,0)3
A study of representative works in the genre from the Baroque period to the present. Prerequisite: 74-261, 262. White.
- 74-366 THE SYMPHONY (3,0)3
A study of the symphonic literature from Haydn to Mahler, using scores and recordings. Prerequisite: 74-261, 262.
- 74-459 PERFORMANCE PRACTICE (3,0)3
The course functions as a seminar exploring performance practices of western art music from the middle ages to the present. Espinosa.
- 74-461 MUSIC OF THE MIDDLE AGES (3,0)3
The theory, notations, forms and styles of music from patristic times to 1400 are examined in depth. Prerequisite: 74-261. Ogasapian.
- 74-462 MUSIC OF THE RENAISSANCE (3,0)3
A study of mass, motet, chanson, madrigal and instrumental music of the fifteenth and sixteenth centuries. Prerequisite: 74-261. White.
- 74-463 MUSIC OF THE BAROQUE (3,0)3
A stylistic study of the music of the period from 1600-1750. Prerequisite: 74-262. Espinosa.
- 74-464 MUSIC OF THE CLASSIC (3,0)3
A study of the solo, chamber, symphonic and operatic literature from 1720-1820. Prerequisite: 74-262. Espinosa.
- 74-465 MUSIC OF THE ROMANTIC (3,0)3
A study of instrumental and vocal forms and styles from 1820 to 1900. Prerequisite: 74-262. White.
- 74-466 MUSIC OF THE TWENTIETH CENTURY (3,0)3
An examination of the stylistic trends of music from late Romanticism through current experimental forms. Emphasis on listening and analysis, as well as musicological commentary. Prerequisite: 74-262. Trenkamp.
- 74-468 MUSICOLOGY AND RESEARCH I I(ARR)3
Research techniques, basic bibliography and format, including the selection and approval of a thesis topic. Restricted to undergraduate majors in Music History and Literature. Permission of Chairperson. Ogasapian & Staff.
- 74-469 MUSICOLOGY AND RESEARCH II II(ARR)3
A continuation of 74-468. Completion of the thesis. Permission of the Chairperson. Prerequisite: 74-468. Ogasapian & Staff.

DEPARTMENT OF PERFORMANCE

Willis Traphagan, Chairperson

Professors: Donald Bravo, Thomas Elliot, Willis Traphagan

Associate Professors: Calvin Lindblad, Anthony Mele, Natalo Paella, Stuart Smith

Assistant Professors: Ivan Oak, David Martins, Kay Roberts

The Department of Performance offers a major specialization in performance and in performance with options in jazz studies and sound recording technology.

Performance (Bachelor of Music)

Students wishing to pursue the major specialization in performance may apply to the Chairperson of the Department of Performance, and are subject to the following requirements:

Application for Performance Specialization

1. Admission is limited to upperclassmen; application is usually made at the end of the freshman year;
2. Application forms are available at the music office and must be submitted to the Department of Performance Chairperson no later than December 1 for fall auditions, May 1 for spring auditions, and August 15 for summer auditions;
3. Written recommendations from the applied instructor and the appropriate applied coordinator must be submitted to the Chairperson of the Department of Performance by December 6 for fall, May 6 for spring and August 21 for summer.

Admission Requirements

1. Satisfactory grades are required in all applied and ensemble courses;
2. A minimum of thirty music credits are required and must include credit for the following courses:
 - a. Applied Music - 72-101, 102;
 - b. Keyboard Skills - 75-131, 132, or 75-133, 134;
 - c. Harmony, Solfege - 71-101, 102, 103, 104; and
 - d. Ensemble - 2 semesters;
3. A successful audition is required, for which repertoire is developed in consultation with the appropriate applied Coordinator.

Retention in Performance Specialization

1. Satisfactory grades are required in all performance specialization courses and ensembles;
2. Continued full-time enrollment in the prescribed curriculum is required;
3. Recitals are required after the completion of basic music courses:
 - a. A senior recital is required during the semester in which 72-402 is completed.
 - b. Keyboard majors must also participate in a chamber music recital which normally occurs while enrolled in 76-159.
4. Participation in the College of Music Concert Hour is required during each semester of residency.

Appeals Procedure

Students whose enrollments are terminated in the performance specialization may submit written petitions to the Committee of Applied Music Coordinators requesting readmission to the program. All decisions of the Committee in evaluating such petitions is final.

Performance Specialization

I. University Core Requirements		-36 credits
II. Basic Music Courses		-26 credits
Harmony/Solfege	13	
Form & Analysis	3	
Music History & Lit.	6	
Keyboard Skills	2	
Conducting		
III. Applied Music		-23 credits (includes recital)
IV. Ensembles		-20 credits
major ensembles	16	
chamber ensembles	4	
V. Music Electives		-9 credits
(three 3-credit upper level courses)		
VI. Performances Courses		-12 credits
Performance Seminar I	3	
Performance Seminar II	3	
A minimum of three (3) courses from the following list of performance electives:		
Keyboard Pedagogy	2	
Keyboard App. to Study	2	
Applied Kybd Repertoire	2	
Applied Kybd Harmony	2	
Vocal Pedagogy	2	
Diction for the Singer	2	
Solo Song Rep & Perf	2	
Practical Tuning	2	
Practical Intonation	2	
Orchestral Rep for Winds & Percussion	2	
Contemporary Rep & Performance Techniques	2	
Techniques for Perf Preparation	2	
Vocal Solfege	2	
Instrumental Solfege	2	
Jazz Theory/Solfege	2	

COURSE OF STUDY FOR PERFORMANCE SPECIALIZATION#

Semester I		Semester II	
71-101 Harmony I	2	71-102 Harmony II	3
71-103 Solfege I	3	71-104 Solfege II	2
72-1-1 Applied Music I	2	72-1-2 Applied Music II	2
* 75-131 Introduction to Keyboard I	(1)	* 75-132 Introduction to Keyboard II	(1)
**75-133 Keyboard Accompanying I	(1)	**75-134 Keyboard Accompanying II	(1)
76- Ensemble	2	76- Ensemble	2
42-101 College Writing I	3	42-102 College Writing II	3
39-1 Physical Education	1	39-1 Physical Education	1
UCR	3	UCR	3
	17		17
Semester III		Semester IV	
71-201 Harmony II	3	†Music Elective	3
74-261 Music History & Literature	3	74-262 Music History & Literature	3
Performance Elective		Performance Elective	2
75-233 Conducting I	1	75-234 Conducting II	1
72-2-1 Performance Applied I	3	72-2-2 Performance Applied II	3
76- Ensemble	2	76- Ensemble	2
UCR	3	UCR	3
	17		17

Semester V		Semester VI	
*Music Elective	3	*Music Elective	3
Performance Elective	2	*5-394 Performance Seminar I	3
72-3 - Performance Applied III	3	72-3 2 Performance Applied IV	3
76- Ensemble	2	76- Ensemble	2
76- Chamber Ensemble	1	76- Chamber Ensemble	1
UCR	3	UCR	3
	14		15
Semester VII		Semester VIII	
75-493 Performance Seminar II	3	*Music Elective	3
72-4-1 Performance Applied V	3	72-4-2 Performance Applied VI	**4
76- Ensemble	2	76- Ensemble	2
76- Chamber Ensemble	1	76- Chamber Ensemble	1
UCR	6	UCR	3
	15		13

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*non keyboard majors only

**Keyboard majors only

†of the four 3-credit music electives, one must be Form & Analysis

**recital semester

Jazz Studies (Bachelor of Music)

Students wishing to elect the jazz studies option in performance may apply to the Director of Jazz Studies subject to the following requirements:

Application for Jazz Studies Option in Performance

1. Applications are usually submitted at the end of the freshman year;
2. Application forms are available at the music office and must be submitted to the Director of Jazz Studies no later than December 1 for fall, May 1 for spring and August 15 for summer;
3. Written recommendations from the applied instructor and the appropriate applied Coordinator must be submitted to the Director of Jazz Studies by December 6 for fall, May 6 for spring and August 21 for summer;

Admission Requirements

1. Satisfactory grades are required in all music courses;
2. A minimum of thirty music credits are required and must include credit for the following courses:
 - a. Applied Music - 72-1-1, 1-2;
 - b. Keyboard Skills - 75-131, 132 or 75-133, 134;
 - c. Harmony, Solfege - 71-101, 102, 103, 104; and
 - d. Ensemble - 2 semesters;
3. A successful audition is required, for which repertoire is developed in consultation with the appropriate applied Coordinator and the applied instructor.

Retention in Jazz Studies Option

1. Satisfactory grades are required in all jazz studies courses and related ensembles;
2. Continued full-time enrollment in the prescribed curriculum is required;
3. Participation in ensembles for each semester of residency is required.

COURSE OF STUDY FOR JAZZ STUDIES#

Freshman Year		Semester II	
Semester I		71-102 Harmony II	3
71-101 Harmony I	3	71-104 Solfege II	2
71-103 Solfege I	3	75- Keyboard Skills*	1
73- Keyboard Skills*	1		

72- Applied Music	2	72- Applied Music	2
76- Ensemble	2	76- Ensemble	2
42-101 College Writing I	3	42-102 College Writing II	3
UCR	3	UCR	3
39- P.E.	1	39- P.E.	1
	17		17
Sophomore Year			
Semester III		Semester IV	
71-203 Harmony III	3	75-361 Jazz Improvisation I	3
74-261 Survey Music History	3	74-262 Survey Music History II	3
75-265 Jazz Keyboard I	1	71-327 Jazz Arranging I	3
72- Applied Music	2	75-266 Jazz Keyboard II	1
76- Ensemble	2	72- Applied Music	2
UCR	3	Ensemble	2
	14	UCR	3
			17
Junior Year			
Semester V		Semester VI	
74-357 Origins of Jazz	3	71- Form & Analysis	3
71-328 Jazz Arranging II	3	Music Elective	3
Music Elective	2	72- Applied Music	2
75-362 Jazz Improvisation II	3	76- Ensemble	2
72- Applied Music	2	UCR	3
76- Ensemble	2		13
UCR	3		
	18		
Senior Year		Semester VIII	
Semester VII		Music Elective	3
75-391 Recording Technology	3	75- Jazz Elective	3
75- Jazz Elective	3	72- Applied Music & Recital**	3
72- Applied Music	3	76- Ensemble	2
75- Ensemble	2	UCR	3
UCR	6		14
	17		

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Keyboard skills - Introduction to Keyboard I & II - non-keyboard majors. Keyboard Accompanying I & II - keyboard majors

**At least fifty per cent of the recital must include jazz compositions.

Sound Recording Technology (Bachelor of Music)

Students wishing to elect the Sound Recording Technology option may apply to the Director of Sound Recording Technology. Applications are normally submitted at the end of the freshman year.

Admission Requirements

1. Satisfactory grades in all music courses. At a minimum, each applicant must have successfully completed Harmony I and II, Solfege I and II, Introduction to Keyboard I and II, and two semesters each of Applied Music and Ensemble;
2. A successful audition in the student's major performance medium (the Director and/or faculty of the program will assist the student in selecting appropriate repertoire);
3. Demonstrated readiness to undertake the calculus "B"-sequence (satisfactory completion of Pre-calculus Mathematics and College Trigonometry courses *or* passing grades on the corresponding Mathematics Department qualifying examinations *or* passing grades on the appropriate CLEP tests);

Requirements for retention in the Sound Recording Technology option

1. Satisfactory grades in all music and recording technology courses and in required mathematics, physics, and electrical engineering courses;
2. Continued full-time enrollment in the prescribed curriculum.
3. Participation in ensembles for each semester of residency.

COURSE OF STUDY FOR SOUND RECORDING TECHNOLOGY#

Semester I		Semester II	
71-101	Harmony I	71-102	Harmony II
71-103	Solfege I	71-104	Solfege II
71-131	Intro to Keyboard I	71-132	Intro to Keyboard II
72-	Applied Music	72-	Applied Music
76-	Ensemble	76-	Ensemble
92-121	Pre-Calculus	92-115	College Trigonometry
42-101	College Writing I	42-102	College Writing II
	16		16
Semester III		Semester IV	
71-201	Harmony III	79-202	Intro to Recording
75-233	Conducting I	75-234	Conducting II
72-	Applied Music	72-	Applied Music
76-	Ensemble	76-	Ensemble
	Area I course	95-151	Elements of Physics*
92-131	Calculus B-I	92-132	Calculus B-II
	15		16
Semester V		Semester VI	
79-371	Recording Technology I	79-372	Recording Technology II
72-	Applied Music	72-	Applied Music
76-	Ensemble	76-	Ensemble
74-261	Music History & Lit I	74-262	Music History & Lit II
71-300	Form and Analysis	95-	Physics**
16-211	Fund of Electricity	16-212	Introductory Electronics
	16		16
Semester VII		Semester VIII	
79-401	The Reading Industry	79-493/495	Internship/Sr. Project
72-	Applied Music	72-	Applied Music
76-	Ensemble	76-	Ensemble
	Advanced Music Elective		Advanced Music Elective
	Area I course		Unrestricted/ROTC
	3		3
	16		16

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Also requires laboratory, 96-151

**Physics of High-fidelity, Physics of Sound and Music, or other appropriate Physics elective

Applied Music (Course Prefix: 72)

Studio instruction in graduated sequence on the principal instrument. Enrollment is based upon criteria stated under GENERAL COLLEGE REQUIREMENTS. I, II (0.5,0) 2 crdts

72-101	Applied Keyboard I	Lindblad C	2.0
72-102	Applied Keyboard II	Lindblad C	2.0
72-111	Applied Voice I	Oak I	2.0
72-112	Applied Voice II	Oak I	2.0
72-121	Applied Woodwinds I	Bravo D	2.0
72-122	Applied Woodwinds II	Bravo D	2.0
72-131	Applied Brass & Perc I	Paella N	2.0
72-132	Applied Brass & Perc II	Paella N	2.0
72-141	Applied Strings I	Roberts, K	2.0
72-142	Applied Strings II	Roberts, K	2.0
72-201	Applied Keyboard III	Lindblad C	2.0
72-202	Applied Keyboard IV	Lindblad C	2.0
72-211	Applied Voice III	Oak I	2.0
72-212	Applied Voice IV	Oak I	2.0
72-221	Applied Woodwinds III	Bravo D	2.0
72-222	Applied Woodwinds IV	Bravo D	2.0
72-231	Applied Brass & Perc III	Paella N	2.0
72-232	Applied Brass & Perc IV	Paella N	2.0
72-241	Applied Strings III	Roberts, K	2.0
72-242	Applied Strings IV	Roberts, K	2.0
72-301	Applied Keyboard V	Lindblad C	2.0
72-302	Applied Keyboard VI	Lindblad C	2.0
72-311	Applied Voice V	Oak I	2.0
72-312	Applied Voice VI	Oak I	2.0

72-321 Applied Woodwinds V	Bravo D	2.0
72-322 Applied Woodwinds VI	Bravo D	2.0
72-331 Applied Brass & Perc V	Paella N	2.0
72-332 Applied Brass & Perc VI	Paella N	2.0
72-341 Applied Strings V	Roberts, K	2.0
72-342 Applied Strings VI	Roberts, K	2.0
72-401 Applied Keyboard VII	Lindblad C	2.0
72-402 Applied Keyboard VIII	Lindblad C	2.0
72-411 Applied Voice VII	Oak I	2.0
72-412 Applied Voice VIII	Oak I	2.0
72-421 Applied Woodwinds VII	Bravo D	2.0
72-422 Applied Woodwinds VIII	Bravo D	2.0
72-431 Applied Brass & Perc VII	Paella N	2.0
72-432 Applied Brass & Perc VIII	Paella N	2.0
72-441 Applied Strings VII	Roberts, K	2.0
72-442 Applied Strings VIII	Roberts, K	2.0
72-443 App Music	Traphagan W	2.0
72-444 App Music	Traphagan W	2.0

Studio instruction in graduated sequence on the principal instrument for performance majors. Enrollment is based upon criteria stated under PERFORMANCE SPECIALIZATION. I, II (1,0) 3 or 4 credits.

72-251 Perf Keyboard I	Lindblad C	3.0
72-252 Perf Keyboard II	Lindblad C	3.0
72-261 Perf Voice I	Oak I	3.0
72-262 Perf Voice II	Oak I	3.0
72-271 Perf Woodwinds I	Bravo D	3.0
72-272 Perf Woodwinds II	Bravo D	3.0
72-281 Perf Brass & Perc I	Paella N	3.0
72-282 Perf Brass & Perc II	Paella N	3.0
72-291 Perf Strings I	Roberts, K	3.0
72-292 Perf Strings II	Roberts, K	3.0
72-351 Perf Keyboard III	Lindblad C	3.0
72-352 Perf Keyboard IV	Lindblad C	3.0
72-361 Perf Voice III	Oak I	3.0
72-362 Perf Voice IV	Oak I	3.0
72-371 Perf Woodwinds III	Bravo D	3.0
72-372 Perf Woodwinds IV	Bravo D	3.0
72-381 Perf Brass & Perc III	Paella N	3.0
72-382 Perf Brass & Perc IV	Paella N	3.0
72-391 Perf Strings III	Roberts, K	3.0
72-392 Perf Strings IV	Roberts, K	3.0
72-451 Perf Keyboard V	Lindblad C	3.0
72-452 Perf Keyboard VI	Lindblad C	4.0
72-461 Perf Voice V	Oak I	3.0
72-462 Perf Voice VI	Oak I	3.0
72-471 Perf Woodwinds V	Bravo D	3.0
72-472 Perf Woodwinds VI	Bravo D	4.0
72-481 Perf Brass & Perc V	Paella N	3.0
72-482 Perf Brass & Perc VI	Paella N	4.0
72-491 Perf Strings V	Roberts, K	3.0
72-492 Perf Strings VI	Roberts, K	4.0
72-493 Perf Applied Music	Traphagan W	3.0
72-494 Perf Applied Music	Traphagan W	3.0
72-495 Perf Applied Music	Traphagan W	3.0
72-496 Perf Applied Music	Traphagan W	4.0

Performance Courses (Prefix: 75)

75-106 CLASS PIANO I, II(3,0)3
Basic introduction to the piano for non-music majors. Open to all students without pre-requisite. Lindblad.

75-131 INTRODUCTION TO KEYBOARD I I(2,0)1
The emphasis is placed on such keyboard skills as the playing of scales, basic chord progressions, harmonization of melodies, accompaniment patterns, basic solo literature and development of keyboard reading necessary to a working knowledge of the keyboard. Mele

75-132 INTRODUCTION TO KEYBOARD II II(2,0)1
A study of more advanced chord progressions, ensemble keyboard playing, patriotic songs, more advanced accompaniment patterns and advanced solo literature. Mele

- 75-133 KEYBOARD ACCOMPANYING I** I(2,0)1
A study of accompanying techniques as they apply to the literature for voice and instruments with piano accompaniment. In-class performance and accompanying for juries and recitals. Lindblad, Mele
- 75-134 KEYBOARD ACCOMPANYING II** II(2,0)1
A continuation of 75-133 utilizing more advanced literature and further discussion of accompanying techniques. In-class performances and accompanying for juries and recitals. Lindblad, Mele
- 75-233 CONDUCTING I** I(2,0)1
Training in basic baton technique and related study for instrumental and choral conducting. Roberts.
- 75-234 CONDUCTING II** II(2,0)1
Continuation of 75-233 exploring more advanced choral and instrumental conducting techniques. Roberts.
- 75-253 KEYBOARD PEDAGOGY**
Emphasis on studio teaching of beginning, intermediate and early advanced students. Aspects of establishing and maintaining a studio (business aspects, tax, equipment, bookkeeping, etc.). Survey of literature for teaching purposes; ways of approaching various concepts, such as reading notes, rhythmic understanding, dynamics, etc. Lindblad, Mele. 2 cr.
- 75-254 KEYBOARD APPROACHES TO STUDY**
Examines various possible ways of learning music and preparing for performance. Covers aspects of practice, facets of memorization and the development of habits which lead to keyboard security. Lindblad. 2 cr.
- 75-265 JAZZ KEYBOARD I** I(2,0)1
A study of chord progressions, blues scales, chord voicings and melodic harmonization, Mele
- 75-266 JAZZ KEYBOARD II** II(2,0)1
A continuation of 75-265. Will introduce the use of chord substitutions and extensions, melodic analysis as well as the study of various piano styles. Mele
- 75-333 CONDUCTING III**
A continuation of Conducting II (75-234) for advanced students. Permission of instructor required. Prerequisite: 75-234. Traphagan. 1 cr.
- 75-353 APPLIED KEYBOARD REPERTOIRE**
The study and performance of smaller and larger works common to the keyboard repertoire: song form, minuet and trio, prelude, intermezzo, nocturne, impromptu, bagatelle and sonata allegro. Lindblad. 2 cr.
- 75-361 IMPROVISATION I** I(3,0)3
A study of basic jazz structures, motives, chord progressions, scales, melodic analysis, use of some approach techniques, tensions and their application to the jazz style. Includes in-class performance by small instrumental and/or vocal groups.
- 75-362 IMPROVISATION II** II(3,0)3
A continuation of 75-361. Will emphasize the study and performance of more advanced levels of improvisation.
- 75-363 STAGE BAND PRACTICES** I, II(3,0)3
A study of instrumental techniques, interpretation of rhythmic and melodic figures as they apply to the Stage Band. In-class performances of representative jazz arrangements will be included.
- 75-373 PRACTICAL TUNING**
The study of orchestral and band instruments relative to tuning. An analysis of the various individual and technical adjustments necessary to arrive at tuning unanimity and the development of a rudimentary concept of pitch and the practical application of these principles to each individual instrument. Bravo. 2 cr.
- 75-374 PRACTICAL INTONATION**
The study of orchestral and band instruments relative to intonation. The development of conceptual awareness relative to the various characteristics of pitch, which are inherent in the design of the various instruments. Identification of problematic intonation and procedures to alleviate problems through performance. Bravo. 2 cr.
- 75-383 ORCHESTRAL REPERTOIRE FOR WINDS & PERCUSSION**
The course is designed as a repertoire reading session dealing with the standard literature of the symphony

orchestra, with emphasis on the larger works that are heavily scored for winds. The majority of class time will be devoted to a study of articulation, style, intonation and phrasing as these aspects of the music under consideration relate specifically to the wind instruments. Paella. 2 cr.

75-384 CONTEMPORARY REPERTOIRE AND PERFORMANCE TECHNIQUES

A course designed to acquaint the student with various techniques and specialized notational practices from the contemporary repertoire, through actual rehearsals, demonstrations and possible student performances. Representative composers include, among others, Berio, Crumb, Ives, Penderecki and Stravinsky. Open to non-performance majors with permission of the instructor. Roberts. 2 cr.

75-385 TECHNIQUES FOR PERFORMANCE PREPARATION

A study of various methods and techniques performers may employ in the process of performance preparation. Techniques for visualization, memorization and aural recall will be included. Emphasis will be placed on student discussion and demonstration. Traphagan. 2 cr.

75-394 PERFORMANCE SEMINAR I

The study and performance of selected works from the repertoire of each of the five primary areas of performance; keyboard, voice, woodwinds, strings and brass/percussion. Emphasis will be placed on student and faculty performance, leading to detailed consideration of the relationship between the demands of the composer and the problems of the performer and the manner in which these concerns influence the musical and artistic judgements necessary to achieve a quality performance. Department faculty. 3 cr.

75-463 VOCAL PEDAGOGY

The study of current techniques in vocal pedagogy, examined through discussion, interviews, observation of studio teaching, demonstrations and outside readings. During the second half of the semester, class members are assigned to teach students who have had little or no vocal training. Class members are expected to do some research work on vocal repertoire for beginners and advanced students. The course is also appropriate for conductors and accompanists. Oak. 2 cr.

75-464 DICTION FOR THE SINGER

The course is designed to acquaint the singer, conductor and accompanist with techniques of enunciation in Italian, German and French as related to the English language.

Will include a comparison of sung and spoken language. Students will also learn the International Phonetic Alphabet, which applies for all languages. Song repertoire assignments and performance exercises will be utilized. Oak. 2 cr.

75-465 SOLO SONG REPERTOIRE AND PERFORMANCE

An extensive study and research of solo song literature in German, French, Italian and English from all major periods of history. The class will also focus on various historical backgrounds, styles of important composers and poets from many different nations. Students will learn how to select suitable songs appropriate to the basic physical nature of individual voices, as well as the various stages of vocal and intellectual maturity. The class will be exposed to the concepts of preparing, memorizing, performing, recital program building as well as stage deportment. Students are expected to perform for the class frequently throughout the semester. Oak. 2 cr.

75-493 PERFORMANCE SEMINAR II

This course is designed as a "master class" experience for students in each of the five primary areas of performance; keyboard, voice, woodwinds, strings and brass/percussion, with a separate section for each area wherever possible. Class sessions will consist of student performances of selected literature, followed by critical analysis from faculty and peers. Each section will be supervised by the appropriate area Coordinator, and will also involve invited guest performers selected from faculty, applied faculty and other noted artists. Note: 75-394 is *not* a pre-requisite for 75-493. Department faculty. 3 cr.

75-495 DIRECTED STUDY AND RESEARCH IN PERFORMANCE

Permission of Chairperson required. Traphagan & staff. 3 cr.

Ensembles (Prefix: 76)

76-101 SYMPHONY ORCHESTRA

I, II(4,0) 2 cr

Open to all students by audition. Works from the orchestral repertoire are studied and publicly performed, with additional opportunities for choral and solo accompaniment. Roberts

- 76-102 WIND ORCHESTRA I, II(4,0) 2 cr
Open to all students by audition. A wide variety of works for wind and percussion instruments are studied and performed. Traphagan
- 76-103 WIND SINFONIA I, II(4,0) 2 cr
Open to all students by audition. Compositions are selected from a wide repertoire of wind ensemble literature for study and performance. Opportunity for solo performance with wind ensemble accompaniment. Elliot.
- 76-104 SYMPHONY BAND I(4,0) 2 cr
Open to all students by audition. Works selected from the symphonic band repertoire are studied and performed.
- 76-105 CONCERT BAND I(4,0) 2 cr
Open to all students by audition. Selected band repertoire studied and performed. Martins
- 76-106 MARCHING BAND I(4,0) 2 cr
Open to all students of the University, without regard for major field of study. The Marching Band performs at all ULowell home football games and appears throughout New England at selected band competitions. "Corps style" marching and special musical arrangements are featured. No audition required.
- 76-107 REPERTORY BAND II(4,0) 2 cr
Open to all students by audition. Emphasis on reading and rehearsing a wide selection of band literature. Some public performance. Martins.
- 76-108 STUDIO ORCHESTRA I, II(4,0) 2 cr
Open to all students by audition. A wide spectrum of jazz orchestration and solo performance is studied and performed. Longstreth, Buda
- 76-151 BRASS ENSEMBLE I, II(2,0) 1 cr
Open to all students by audition. Provides a wide range of performance experience through varied brass literature. Paella.
- 76-152 STRING ENSEMBLE I, II (as required)(2,0) 1 cr
Open to all students by audition. Provides experience with string chamber literature.
- 76-153 PERCUSSION ENSEMBLE I, II(2,0) 1 cr
Open to all students by audition. Exploration of the growing body of literature for percussion ensemble. Public performance. Beale.
- 76-154 PIANO ENSEMBLE I, II(2,0) 1 cr
Open to all students by audition. Provides performance experiences through varied piano ensemble literature. Lindblad.
- 76-155 STRING QUARTET I, II(as required)(2,0) 1 cr
Open to all students by audition. Study of the vast string quartet literature.
- 76-156 GUITAR ENSEMBLE I, II(2,0) 1 cr
Open to all students by audition. Provides study and performance of literature for guitar, lute, etc. Required of all guitar majors each semester. Anderson.
- 76-157 WOODWIND QUINTET I, II(as required)(2,0) 1 cr
Open to all students by audition. Offers study and performance of literature for woodwind quartet. Bravo.
- 76-158 SAXOPHONE QUARTET I, II(as required)(2,0) 1 cr
Open to all students by audition. Offers study and performance of literature for saxophone quartet. Bravo.
- 76-159 CHAMBER ENSEMBLE I,II(2,0) 1 cr
Open to all students by audition. Offers a wide range of performance experience through a selection of literature for varying combinations of instruments. Lindblad.
- 76-160 STRING ORCHESTRA I, II(2,0) 1 cr
Open to all students by audition. Provides experience in the performance of string orchestra literature. Roberts.

- 76-201 CONCERT CHOIR I, II(4,0) 2 cr
Open to all students by audition. Provides for the study and performance of a wide variety of choral compositions. Lannom.
- 76-202 COLLEGIATE CHORALE I, II(4,0) 2 cr
Open to all students by audition. Includes the study and performance of a wide variety of choral compositions. White.
- 76-203 CONSORTIUM ARTIS MUSICAE I, II(4,0) 2 cr
Open to all students by audition. Devoted to the study and performance of a variety of early vocal and instrumental music. White.
- 76-204 OPERA STUDIO I, II(4,0) 2 cr
Open to all students by audition. Offers experience in the theory and practice of opera performance. Includes preparation of roles, rehearsal techniques, ensemble singing and operatic traditions. Oak.
- 76-210 OPERA WORKSHOP I, II(4,0) 3 cr
Open to all students. Practical experience in the non-performing aspects of operatic and Broadway show production.
- 76-251 UNIVERSITY CHORUS I, II(2,0) 1 cr
Open to the entire university and community. Major choral works are studied and prepared for public performance. Lannom.
- 76-253 JAZZ SWING CHOIR I, II(2,0) 1 cr
Open to all students by audition. Provides opportunity for study and performance of jazz choral literature. Mele.

Sound Recording Technology (Prefix: 79)

- 79-202 INTRODUCTION TO RECORDING II(3,0) 3 cr
The fundamental principles and techniques of audio recording, including practical hands-on experience with tape recorders, mixing console, and microphones.
- 79-371 SOUND RECORDING TECHNOLOGY I I(3,0) 3 cr
Theory and use of the major components of the modern recording studio: multitrack tape recorders, mixing consoles, microphones, monitoring system, and signal processing equipment. Planning and execution of recording sessions which involve a variety of musical ensembles under a variety of recording conditions. Advanced multitrack recording, overdub, and remix procedures. Application of informed musical judgement to the mixing process.
- 79-372 SOUND RECORDING TECHNOLOGY II II(3,0) 3 cr
A continuation of 79-371.
- 79-401 THE RECORDING INDUSTRY I(3,0) 3 cr
An in-depth survey of the professional practices of recording studios, label companies, pressing companies, and other components of the recording industry.
- 79-493 INTERNSHIP I, II(ARR) 6 cr
Practical experience in audio recording under supervision of professional firms.
- 79-495 SENIOR PROJECT I, II(ARR) 6 cr
Advanced projects developed in consultation with faculty advisor. Typical projects include production of a complete record album, investigation of experimental recording techniques, and original research in recording technology.

DEPARTMENT OF MUSIC EDUCATION

Paul Gayzagian, Chairperson

Professor: Paul Gayzagian

Associate Professors: William Pordon, Rawn Spearman

Assistant Professors: Ruth Ashley, Robert White

Music Education (Bachelor of Music)

1. *Intro. to Music Education* is a prerequisite for professional courses in music education.
2. All music education students must accumulate credits in both vocal and instrumental ensembles. Each music ed. major must have minimum of one semester of choral experience and one semester of instrumental experience.
3. Laboratory experiences *may* fulfill the requirement above but cannot be included in the basic music ensemble requirement of 16 credits.
4. Laboratory Chorus is open to instrumental and keyboard majors only.
Laboratory Orchestra/Band are open to vocal and keyboard majors, and to the instrumental major who is not playing his/her major instrument.
5. Prerequisite courses for laboratory groups:
 - a. Appropriate instrumental class.
 - b. Conducting I.
6. *Marching Band Techniques* is a prerequisite for all instrumental majors who register for *Music Methods 5-12.*

COURSE OF STUDY FOR MUSIC EDUCATION#

Freshman Year		Spring Semester	
Fall Semester		Harmony/Solfege II	5
Harmony/Solfege I	5	Applied Music	2
Applied Music	2	Ensemble	2
Ensemble	2	Intro to Keyboard II	1
Intro to Keyboard I	1	Keyboard Accompanying	
Keyboard Accompanying		College Writing	3
College Writing	3	UCR	3
UCR	3	*Physical Education	1
Physical Education	1	Music Elective (Group A)	1
	17		18
Sophomore Year		Spring Semester	
Fall Semester		Conducting II	1
Harmony/Solfege III	3	Music Elective	3
Applied Music	2	(History, Theory, Form & Analysis	
Ensemble	2	Applied Music	2
Conducting I	1	Ensemble	2
Survey of Music Hist. I	3	Surv. of Mus. Hist. II	3
UCR-Lab Science	4	UCR	3
Music Elective (Group A, B)	2	Music Elective (Group A or B)	2
	17		16
Junior Year		Spring Semester	
Fall Semester		Music Elective	3
Music Elective	3	(History, Theory, Form & Analysis 2 UCR	6
History, Theory, Form & Analysis 2 UCR	6	Ensemble	2
Ensemble	2	Applied Music	2
Applied Music	2	Hist. & Phil. Prin. & Pract. of Music Ed.	3
Music Elective (Group A, B, C.)	3	Music Elective (Group A, B, C.)	1
	16		17
Senior Year		Spring Semester	
Fall Semester		Student Teaching	12
UCR	3	Ensemble	2
Issues in Music Ed.	3	Applied Music	2
Methods (El. or Sec.)	3		16

Ensemble	2
Applied Music	2
Music Elective (Group A, B, C.)	1
	14

#Core requirements will differ for members of the graduating class of 1987 and subsequent classes.

*Those who take Marching Band as an ensemble may take Inst/Vocal class or intro to Mus. Ed in the freshman year. Each semester spent in Marching Band will waive 1 semester of Physical Education.

Electives

Minimum Requirement

1. Five credits from Group A
2. Three credits from Group B
3. Two credits from Group C

Group A

			Credit
73-141	Instrumental Class I	High Brass (Fall Semester only)	1
73-139	Instrumental Class II	Low Brass (Spring semester only)	1
73-142	Instrumental Class III	Clarinet (Fall semester only)	1
73-242	Instrumental Class IV	Strings	
73-144	Instrumental Class V	Flute (Spring semester only)	1
73-237	Instrumental Class VI	Double Reeds (Fall semester only)	1
73-162	Instrumental Class VII	Percussion (Spring semester only)	1
73-243	Class Voice	1	
73-245	Class Guitar	1	

Group B

73-151	Intro to Music Education	1
71-304	The Moveable "Do" Method	2
71-303	Instrumental Solfege	2
71-305	Jazz Solfege	2
71-374	Aural & Visual Perception III	2
75-333	Conducting III	1

Group C

73-190	*Laboratory Chorus	1
73-191	*Laboratory Orchestra	1
73-192	*Laboratory Band	1
	Chamber Ensemble	1

A minimum of one semester of both choral and instrumental experiences are required for all Music Education majors. Credits for this required category may be earned by participation in major ensembles, chamber ensembles, laboratory chorus, laboratory orchestra, or laboratory band.

* Pre-requisite: Appropriate instrumental class

° Keyboard and Instrumental majors only

□ Pre-requisite for professional courses in music education

+ Pre-requisite for instrumental majors for music methods 5-12

Music Education (Course Prefix: 73)

73-141 INSTRUMENTAL CLASS I - High Brass I, II(2,0)2
Intensive class instruction in the fundamentals of playing brass instruments. The student is expected to gain skill for beginning teaching and demonstration purposes. Paella.

- 73-142 INSTRUMENTAL CLASS II - Low Brass I, II(2,0)2
Intensive class instruction in the fundamentals of playing brass instruments. The student is expected to gain skill for beginning teaching and demonstration purposes. Paella.
- 73-144 INSTRUMENTAL CLASS V - Flute
Intensive class instruction in the fundamentals of playing flute. The student is expected to gain skill for beginning teaching and demonstration purposes. Bravo.
- 73-151 INTRODUCTION TO MUSIC EDUCATION I, II(2,0)2
A program designed to acquaint underclassmen with music education principles and practices. Students will observe music education activities in selected public activities. Periodic seminars with music education faculty will be an integral component of the course. Gayzagian & Staff. 1 cr.
- 73-161 MARCHING BAND TECHNIQUES
Instruction in organizing and developing a marching band. Specific philosophies, techniques, and band literature in a realistic setting with the University Marching Band. Whiston. 1 cr.
- 73-162 INSTRUMENTAL CLASS VII - Percussion
Intensive class instruction in the fundamentals of playing percussion. The student is expected to gain skill for beginning teaching and demonstration purposes. Whiston. 1 cr.
- 73-190 LABORATORY CHORUS
Choral experiences for the non-voice major. Intensive study of public school choral literature; conducting and rehearsal techniques; understanding and developing choral skills. Department. 1 cr.
- 73-191/92 LABORATORY ORCHESTRA/BAND
Instrumental experiences for students on a secondary instrument. Intensive study of public school band/orchestra literature; conducting and rehearsal techniques; understanding and developing skills on secondary instruments. Department. 1 cr.
- 73-237 INSTRUMENTAL CLASS VI - Double Reeds
Intensive class instruction in the fundamentals of playing double reeds. The student is expected to gain skill for beginning teaching and demonstration purposes. Bravo. 1 cr.
- 73-241 INSTRUMENTAL CLASS III - Clarinet I, II(2,0)2
Intensive class instruction in the fundamentals of playing clarinet. The student is expected to gain skill for beginning teaching and demonstration purposes. Bravo.
- 73-242 INSTRUMENTAL CLASS IV - Strings I, II(2,0)2
Intensive class instruction in the fundamentals of playing string instruments. The student is expected to gain skill for beginning teaching and demonstration purposes. Pordon.
- 73-243 CLASS VOICE I, II(2,0)2
This course is intended to cultivate the fundamental principles of singing. The psychology of singing and physiology of the singing voice are considered as they apply to tone production, resonance. This course is designed for non-voice majors. Ashley and Spearman.
- 73-245 CLASS GUITAR I, II(2,0)2
A course designed to enable students to develop skill in playing guitar and acquiring pedagogical principles of teaching guitar in groups. Anderson.
- 73-251 MUSIC FOR THE CLASSROOM TEACHER I, II(3,0)3
Emphasis on basic musical skills and approaches to enable the elementary classroom teacher to intergrate music in the elementary classroom. Ashley.
- 73-370 HISTORICAL AND PHILOSOPHICAL PRINCIPLES AND PRACTICES IN MUSIC EDUCATION I,II(4,0)4
Examination of the history and different philosophies of music education. Educational and psychological principles and practices in conjunction with field experiences. Gayzagian.
- 73-391 MUSIC METHODS (K-9) IA, IIA(6,0)3
A course designed to prepare students for apprentice teaching in elementary schools. Observations, demonstrations, and actual teaching in selected public school classrooms are integral parts of the course. Ashley.

73-393 MUSIC METHODS (5-12)

IA, IIA(6-0)3

Reviews the characteristics and attitudes of adolescence, and explores teacher attitudes as related to success in music teaching. Provides experience with a variety of approaches and activities appropriate to this level. Pordon.

73-397 ISSUES IN MUSIC EDUCATION

Examination of contemporary issues in music education. Field experiences and team teaching provide the student with a wide variety of sociological, musical, and educational realities. Department.

73-491 APPRENTICE TEACHING OF MUSIC (K-9)

IB, IIB(APR)6

Full-time apprentice teaching of music in public elementary schools under the supervision of qualified classroom teachers, administrators, music specialists, and members of the college faculty. Provides experience for the student in applying contemporary principles and techniques studied in music and music education courses, and in using a wide variety of materials and equipment. Prerequisite: 73-391. Gayzagian & Staff.

73-492 APPRENTICE TEACHING OF MUSIC (5-12)

IB, IIB(APR)6

Full-time apprentice teaching in public secondary schools under the supervision of qualified music specialist administrators, and members of the college faculty. Provides experience for the student in applying contemporary principles and techniques studied in music education courses. Prerequisite: 73-393. Gayzagian & Staff.

FACULTY OF THE COLLEGE OF MUSIC

DEAN OF THE COLLEGE

DEPARTMENT OF CHAIRPERSONS

Paul Gayzagian, B.M.; M.M.; Ed.D.; Music Education
Antone Holevas, B.M.; M.M.; Academic Studies
Willis Traphagan, B.M.; M.M.; Performance

RESIDENT FACULTY

Ruth Ashley, Assistant Professor, Music Education; B.M.Ed., Lowell State College; M.Ed., Fitchburg State College.
Dean Bouzianis, Assistant Professor, Music Theory; B.M., A.M., Boston University; M.M., National Conservatory of Greece.
Donald Bravo, Professor, Performance; B.M., New England Conservatory; M.M., Boston Conservatory.
Jacqueline Charette, Associate Professor, Music Theory; B.M., Rivier College; M.M., Ed.D., Boston University.
Thomas G. Elliot, Associate Professor, Performance; B.M., M.M., D.M.A., Boston University.
Alma O. Espinosa, Assistant Professor, Music History & Literature; B.M., Eastman School of Music; M.M., Plus XII Institute; A.M., Ph.D., New York University.
Paul Gay, Associate Professor, Music Theory; B.M., New England Conservatory; M.M., Boston University.
Paul Gayzagian, Professor, Music Education; B.M., M.M., Ed.D., Boston University.
Antone Holevas, Associate Professor, Music Theory; B.M., Butler University; M.M., Boston University.
Calvin Lindblad, Associate Professor, Performance; B.M., Boston University; M.M., University of Lowell.
David Martins, Assistant Professor; B.M., Eastman School of Music, M.M., University of Lowell.
Anthony Mele, Associate Professor, Performance; B.M., Ithaca College; M.M., Boston University.
Ingul Ivan Oak, Associate Professor, Performance; B.M., M.M., New England Conservatory.
John Ogasapian, Professor, Music History and Literature; B.M., M.A., Ph.D., Boston University.
Natalo Paella, Associate Professor, Performance; B.M., Louisiana State University; M.M., New England Conservatory of Music.
William Pordon, Associate Professor, Music Education; B.M., M.M., Chicago Conservatory College.
Domenic Procopio, Professor, Music Theory, B.A., Harvard University, M.A., Ph.D., Boston University.
Kay Roberts, Assistant Professor, Performance; B.A., Fisk University; M.M., M.M.A., Yale University.
Stuart Smith, Associate Professor, Performance; A.B., Rutgers University; M.F.A., Brandeis University; Ed.D., University of Massachusetts.
Rawn Spearman, Associate Professor, Music Education; B.S., Florida A. & M. University; M.A., Ed.D., Columbia University.
Willis Traphagan, Professor, Performance; B.M., Ithaca College; M.M., Boston University.
W. Anne Trenkamp, Associate Professor, Music Theory; B.A., Ph.D., Case-Western Reserve University; M.M., University of Michigan.
Robert White, Assistant Professor, Music Education; B.M., New England Conservatory; A.M., Harvard University.

ADJUNCT FACULTY

Enice Alberts, Voice; New England Conservatory.
Cheryl Allen, Trumpet; B.M. University of Lowell
Neil Anderson, Guitar; B.M. Hartt College of Music
Dragana Bajalovic, Piano; B.M. Oberlin Conservatory; M.M. New England Conservatory
Everett Beale, Percussion; New England Conservatory
Bela Bozormenyi-Nagy, Piano; Artist Diploma, Franz Liszt Academy of Music, Budapest.
Fred Buda, Percussion; B.M., M.M. Boston University
Harry Chalmiers, Guitar; B.M. Berklee College of Music
Frank Charnley, Oboe; B.M., M.M. New England Conservatory

Thomas Ferrante, Saxophone; B.M. New England Conservatory; M.M. Boston University
 John Fiorito, Voice; New England Conservatory
 Anthony Fulginiti, Clarinet; B.M. New England Conservatory
 Frank Gallagher, Double Bass; B.M. New England Conservatory
 Jacqueline Gourdin, Piano; B.M. Boston Conservatory; M.M. University of Lowell
 Michael Kramer, Piano; B.A. Northeastern University; M.M. Boston University
 Allen Lannom, Vocal Ensembles; B.A. Occidental College; M.A. Boston University
 Inge Lindblad, Piano; Vienna Academy of Art, Vienna Conservatory Longy School of Music
 Virginia Loiselle, Violin; B.M., M.M. New England Conservatory
 Everett Longstreth, Jazz Studies; B.M. Berklee College of Music
 Ellen Martins, French Horn; B.M. University of Lowell
 Barbara McClosky, Voice; A.M. Vassar College
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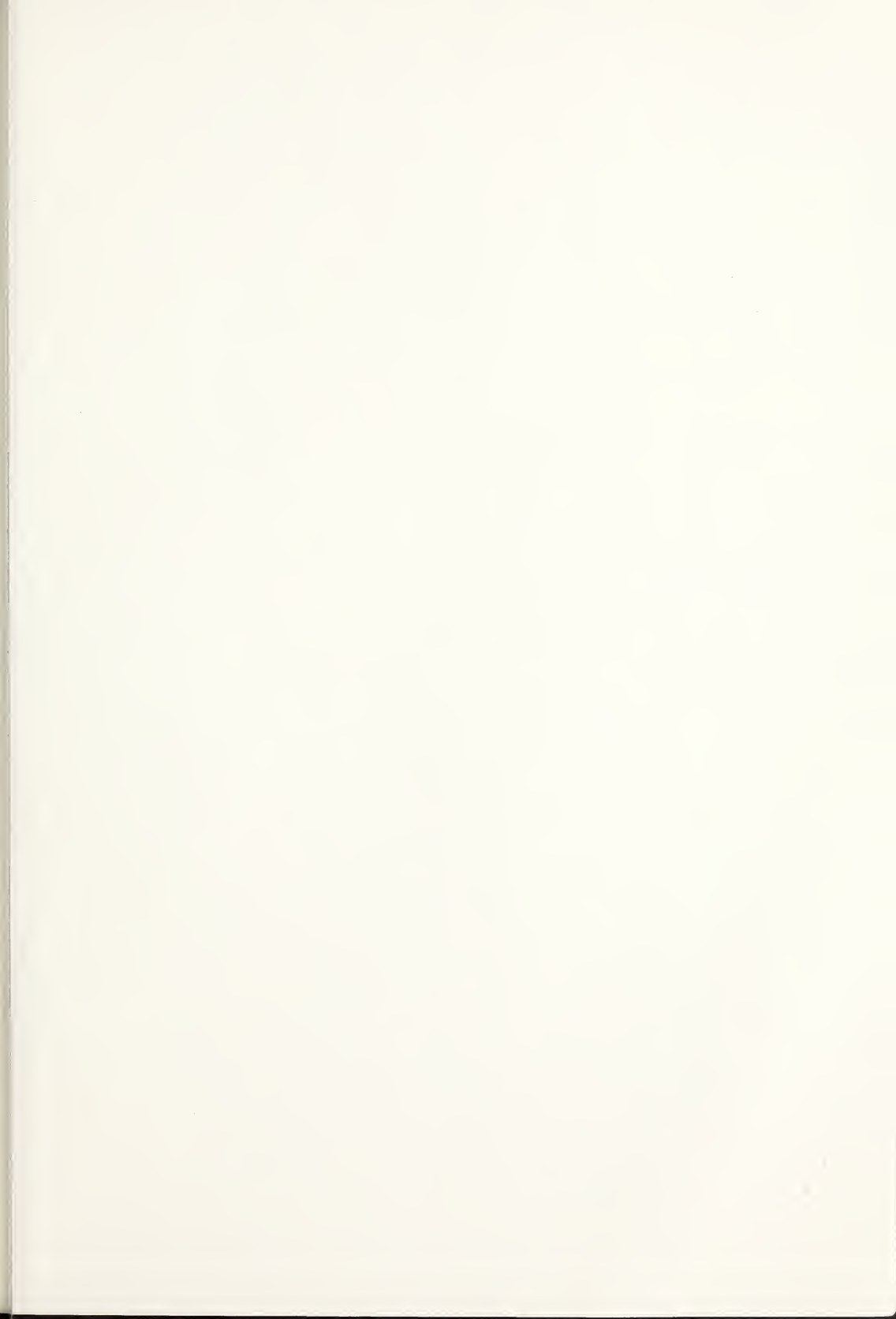
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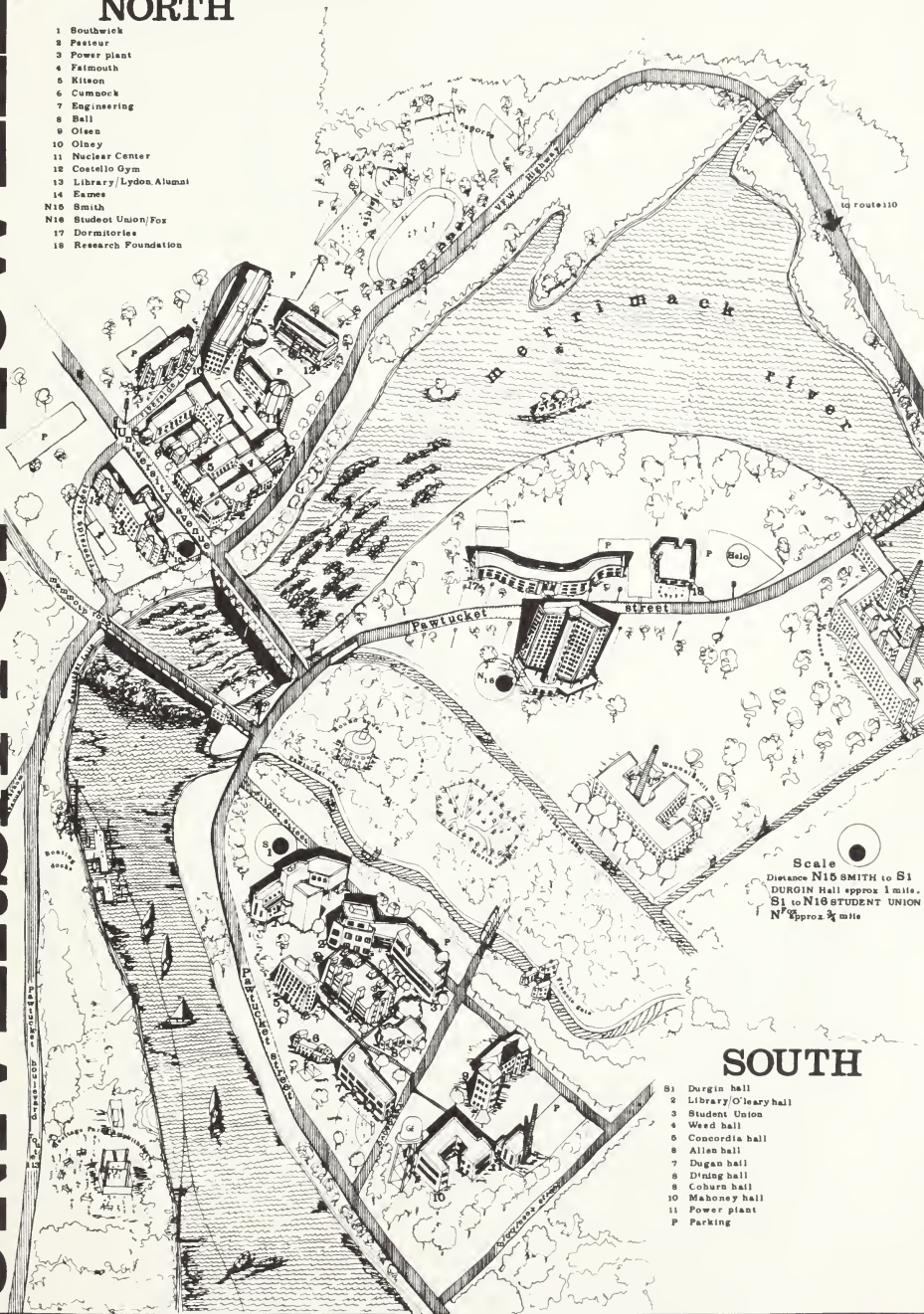




UNIVERSITY OF LOWELL

NORTH

- 1 Southwick
- 2 Posteur
- 3 Power plant
- 4 Falmouth
- 5 Kitson
- 6 Cumstock
- 7 Engineering
- 8 Ball
- 9 Olsen
- 10 Olney
- 11 Nucleus Center
- 12 Costello Gym
- 13 Library/Lydon Alumni
- 14 Eames
- N15 Smith
- N16 Student Union/Fox
- 17 Dormitories
- 18 Research Foundation



Scale

Distance N15 SMITH to S1
DURGIN Hall approx 1 mile.
S1 to N16 STUDENT UNION
N¹ approx 1/2 mile

SOUTH

- S1 Durgin hall
- 2 Library/O'leary hall
- 3 Student Union
- 4 Weed hall
- 5 Concordia hall
- 6 Allen hall
- 7 Dugan hall
- 8 Dining hall
- 9 Coburn hall
- 10 Mahoney hall
- 11 Power plant
- P Parking

University of Lowell
1 University Avenue
Lowell, MA 01854

Third Class Mail